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"Elastomers for Air Weapons" (page 232)

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GAMMA RADIATION AND THE RUBBER INDUSTRY
By S. D. Gehman, page 213

ANNOUNCING

NA-33

An extremely safe thioamide accelerator
for the W types of neoprene (W, WX, WRT and WHV)

1. VERY SAFE PROCESSING YET FAST CURING

2. EXCELLENT VULCANIZATE PROPERTIES

In a Neoprene Type W stock containing 125 parts
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the following properties were obtained:

Mooney Scorch (MS-250°F.) ..... 40 minutes to 10-point rise

	Cure @ 307°F.		
	7.5 min.	15 min.	30 min.
Stress @ 100% Elongation (psi)	475	750	800
Tensile Strength (psi)	1900	2025	2100

Compression Set, ASTM Method B	after 22 hours @ 158°F.	after 70 hours @ 212°F.
(cure: 25 minutes @ 307°F.)	12%	26%

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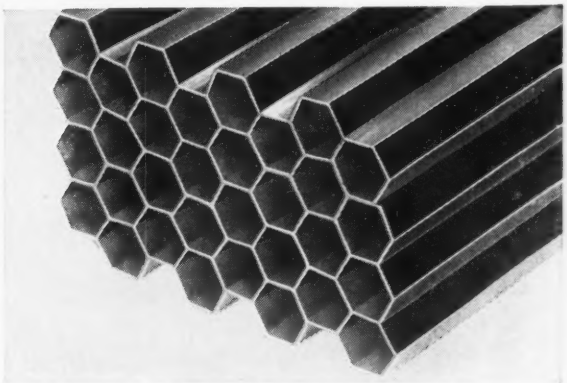
*A trademark

News about

B.F.Goodrich Chemical *raw materials*

*blister resistant Hycar

*new compounds meet industrial specs



One of the new applications of Hycar American Rubber is this honeycomb which is multiple extruded and used as a spring core for freight car journal box lubricators. A unique rubber product, it has exceptional radial spring, axial stiffness and stability of shape and dimension. It withstands temperature extremes, oil immersion and abrasion.

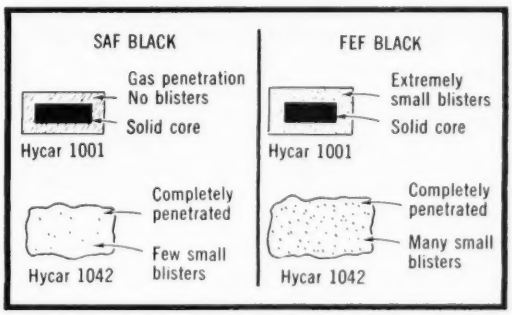
Blister resistant Hycar for high pressure gas service. A new, extremely strong and blister resistant Hycar compound — 1001/SAF — has been developed specifically for making sleeves and diaphragms used in high pressure regulators for the oil and gas industry. Ordinary rubbers proved unsatisfactory because they did not have high oil resistance combined with physical strength to reduce oil and gas penetration; and the ability to withstand internal pressures from entrapped gases after flow pressures up to 3000 psi were removed. This pressure removal often caused severe swelling or complete rupture of parts made from ordinary rubber. Following tests on various Hycar compounds, these conclusions were reached:

(1) High acrylonitrile Hycar polymers perform best.

(2) Loading with fine particle size blacks give highest blister resistance. SAF black provides the best results.

(3) Plasticizers increase blistering. Extractable types are especially bad. Small amounts of non-extractable plasticizer can be used as a processing aid.

(4) The curing system is not important as long as a tight cure is obtained.



Cross sections of several polymers were made after one week's exposure to 100 psi carbon dioxide and 600 psi ethylene. These sections clearly show the superior blister resistance of high acrylonitrile Hycar 1001 and the better performance achieved through SAF Black Loading. Base recipe for this test: Hycar polymers 100.0; Zinc oxide 5.0; Black loading 40.0; TMTD 3.5; Stearic Acid 1.0.

NEW HYCAR COMPOUNDS FOR INDUSTRIAL SPECIFICATIONS

Bendix-Westinghouse Spec 1036-M . . . requiring very low volume change after immersion in ASTM No. 1 and No. 3 oils and satisfactory performance at −40°F. Primary uses: valves and valve seats. *Hycar 1042 compound.*

Military Spec MIL-G-1086A . . . requiring resistance to aviation gasoline, water and asphalt. For gaskets on bolted steel storage tanks. *Hycar 1042 compounds.*

Allison Proposed Spec 22619 . . . requiring a 90±5 Durometer A compound with excellent oil resistance at high temperatures. Two Hycar 1042 compounds meet the spec.

Automotive Spec No. 69 . . . requiring a 70±5 Durometer A compound, good oil resistance and ability to withstand temperature extremes. Applications: lip-type seals and other automotive seals. A Hycar 1042 compound has narrow volume change limits after aging in ASTM No. 1 oil at 300°F; and −15°F low temperature brittleness.

For further information on Hycar nitrile rubber, write Dept. HN-5, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ont.

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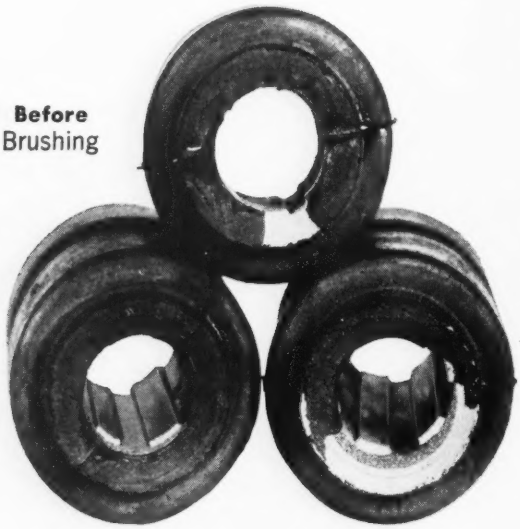
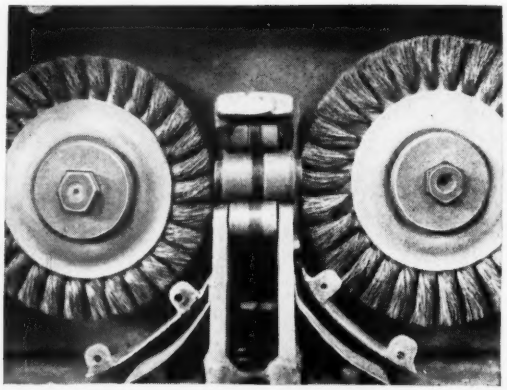
Before
Brushing





Osborn Disc-Center® Brushes, *8" diameter are used to remove flash from mechanical rubber parts, efficiently, economically.*

Removing flash...IN A FLASH!

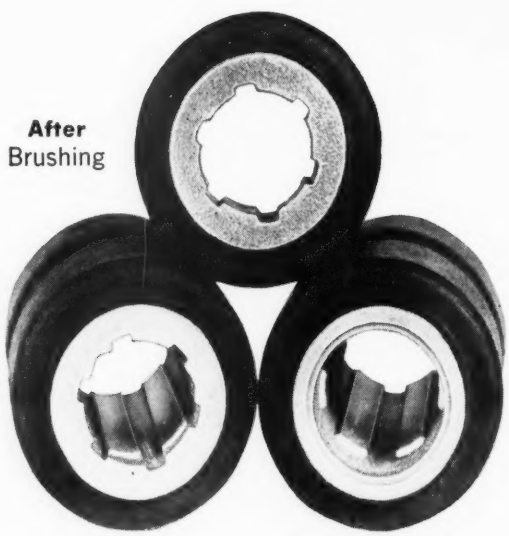
REMOVING flash from mechanical rubber parts by hand was a slow and costly operation before Osborn power brushing methods took over.

With this simple set-up using Osborn Disc-Center® Brushes, a major rubber company has increased production 800% . . . and cut its costs substantially. Results are uniform . . . production consistent throughout the day.

This case is typical of how Osborn power brushing can improve your finishing operations and simplify your methods.

An **O**sborn **B**rushing **A**nalysis, made at no obligation in your own plant, will demonstrate how you can save time and money. Write *The Osborn Manufacturing Company, Dept. M-10, 5401 Hamilton Ave., Cleveland 14, Ohio.*

After
Brushing



Osborn Brushes

Write TODAY for the new 100-page Osborn Catalog 210-C.

BRUSHING METHODS • POWER, PAINT AND MAINTENANCE BRUSHES
BRUSHING MACHINES • FOUNDRY PRODUCTION MACHINERY

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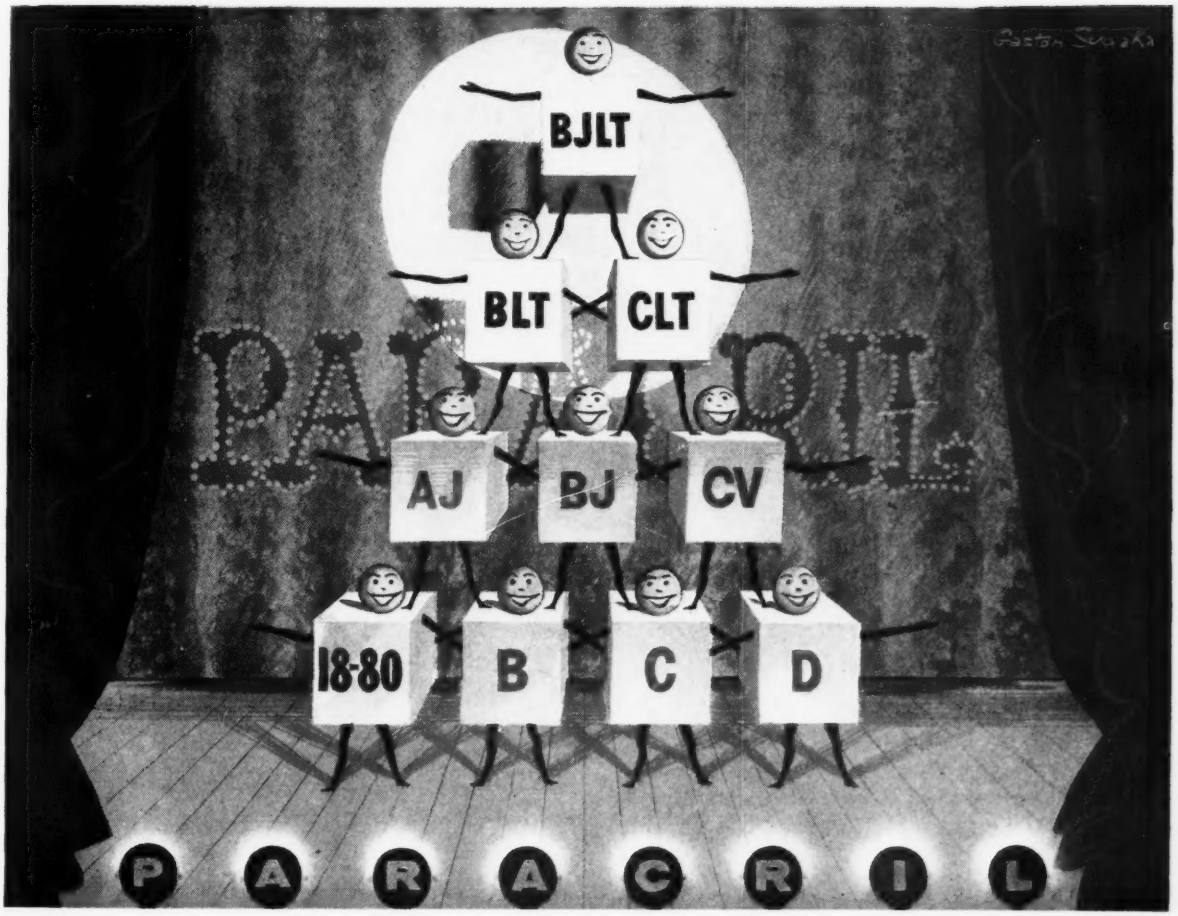

Now... three new "COLD" nitrile rubbers

Three low-temperature-polymerized acrylonitrile rubbers – PARACRILS BLT, BJLT and CLT – have now been added to the growing family of PARACRIL® oil-resistant synthetics. Compared, respectively, to the regular high-temperature-polymerized PARACRIL B and PARACRIL C, they offer:

- Better processing qualities,
- Maximum processing safety,
- Increased resistance to oil, fuel and water,
- Improved physical properties in vulcanizates – particularly in low-hardness compounds.

All three have exceptionally good solvating properties and contain a non-staining, non-discoloring stabilizer – making them adaptable both to oil-resistant mechanical goods and to rubber cements and adhesives. PARACRIL BJLT has a considerably lower Mooney viscosity than BLT; otherwise their properties are similar.

Now, whatever your need for oil-resistant synthetic rubber – with practically any combination of qualities – count on Naugatuck to provide it!

Naugatuck Chemical

Division of United States Rubber Company
Naugatuck, Connecticut

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HARFLEX® 300

A NON-MIGRATORY PLASTICIZER

Migration tests run on samples of PVC plasticized with **HARFLEX® 300** show no effect on polstyrene, or on varnish and alkyd enamel finishes. This permanent polymeric plasticizer has good compatibility and easy processing characteristics that eliminate the need for using secondary plasticizers as processing aids.

Manufacturers of plastic products or plastisols that must be extraction resistant will be interested in testing **HARFLEX® 300**. Samples of **HARFLEX® 300** for test or experimental work are available. Write for our free Technical Bulletin #1002-H which gives full information about this easy processing and efficient plasticizer.

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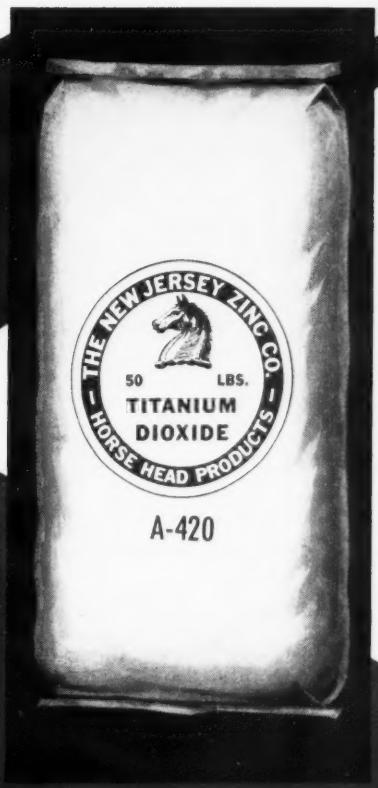
H-20-R

Versatile White for Rubber

'Ho... TITA...

...RSE HEAD'
...NIUM DIOXIDE
A-420
(anatase)



Try A-420 in any of your white or light-colored rubber products and you will find it most versatile. A-420 provides excellent results in a wide range of uses—from colorful drug sundries to white sidewalls that stay white.

A-420 provides excellent whitening power
A-420 incorporates and disperses easily in any elastomer
A-420 disperses readily in latex and, because of low salts content, does not interfere with stability
A-420 imparts excellent dynamic flex-crack resistance in white sidewalls
A-420 retains its brilliant whiteness under all types of service conditions

Our sales representative in your area will be glad to discuss with you the use of A-420, and also specific applications where you can use to advantage some of the other Horse Head anatase and rutile grades.

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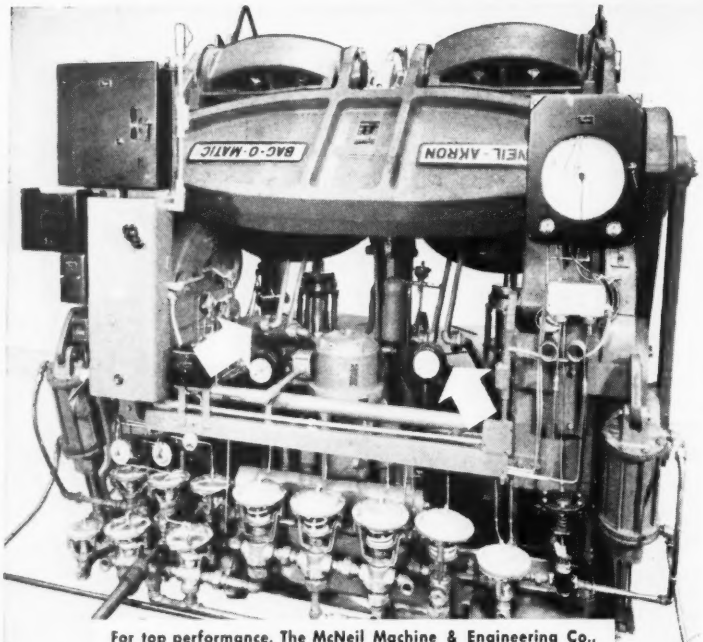
SELF-ALIGNING **BARCO** SWIVEL JOINTS



For top performance, The McNeil Machine & Engineering Co., Akron, Ohio, uses Barco Swivel Joints to make flexible piping connections on this twin platen McNeil Bag-O-Matic press and for water bag connections on other types of tire curing.

Read What Users Say:

- "Joints last 3 or 4 times longer than other methods of providing flexibility —with no maintenance required."
- "With Barco Joints and the new 11CTS gaskets we handle alternating steam and cold water without leakage."
- "Barco Joints on our platen presses *don't get in the way* like non-rigid lines. They permit *accurate temperature control too.*"
- "We're interested in *safety and avoiding shut downs.* Your joints *don't break or fail suddenly.*"
- "Your self-alignment feature makes *installation easy.*"
- "We like your joints because they require so little maintenance. We don't even have to lubricate them."

How Improved Barco Swivel Joints Make Tire Molds, Presses Work Better

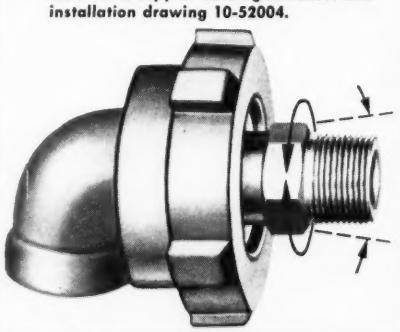
DEPENDABLE, TROUBLE-FREE PERFORMANCE —time after time—has been the one big reason for using Barco Swivel Joints in flexible piping connections and dog-legs on tire molds and platen presses used in the rubber industry. And now Barco offers even *better* performance and service, not only for new uses, but for thousands of existing installations.

The ANSWER is Barco's new, chemically inert No. 11 CTS gasket. No other material is as amazingly long wearing and versatile. Even under most adverse conditions, joints maintain their seal, hot or cold, working or idle—with lower torque and no lubrication required. Natural operating action keeps the hemispherical ball of the joint lapped to a perfect fit.

Get this advanced performance in new Barco Swivel Joints! Send for complete information on MODERNIZING old joints!

USED BY LEADING MACHINE BUILDERS

- **IMPROVED SEAL**—Barco's new No. 11CTS gasket is amazingly long wearing! Does not bake hard. Ideal for steam and water service. Does not cause excess wear on other parts.
- **LEAKPROOF, HOT OR COLD** — Joints stay tight regardless of pressure or temperature.
- **SELF-ALIGNING** — 10° side flexibility. This Barco feature saves piping time, cuts costs, and insures perfect performance.
- **ENGINEERING RECOMMENDATIONS**— Send for a copy of Catalog No. 265A and installation drawing 10-52004.



BARCO MANUFACTURING CO. BARCO **510F Hough Street, Barrington, Illinois**

Now–rubber you can read through!

Clearly different is this sample of compounded PLIOFLEX–the lighter colored synthetic rubber – pictured above. It's the first time ever that such transparency has been achieved in rubber. And what a host of possible uses it brings to mind – shoe soles, hose, tubing, toys, housewares, novelties.

Easier said than done, however, was finding the right combination of materials to produce this "clear" compound. Over 700 formulations were evaluated before success was realized. And of all the rubbers and pigments tested only combinations of PLIOFLEX 1778 and a silica pigment, Hi-Sil 233, permitted the maximum transparency for both hard and soft products.

The reasons why PLIOFLEX fills the bill so well are its extremely light color, its purity and its excellent general physical properties, not to mention its economy. These, incidentally, are the same reasons why PLIOFLEX is so frequently specified for other, more common uses.

What can you do with PLIOFLEX in "clear" rubber or other applications? Start finding out by writing for full details to: Goodyear, Chemical Division, Dept. E-9418, Akron 16, Ohio.

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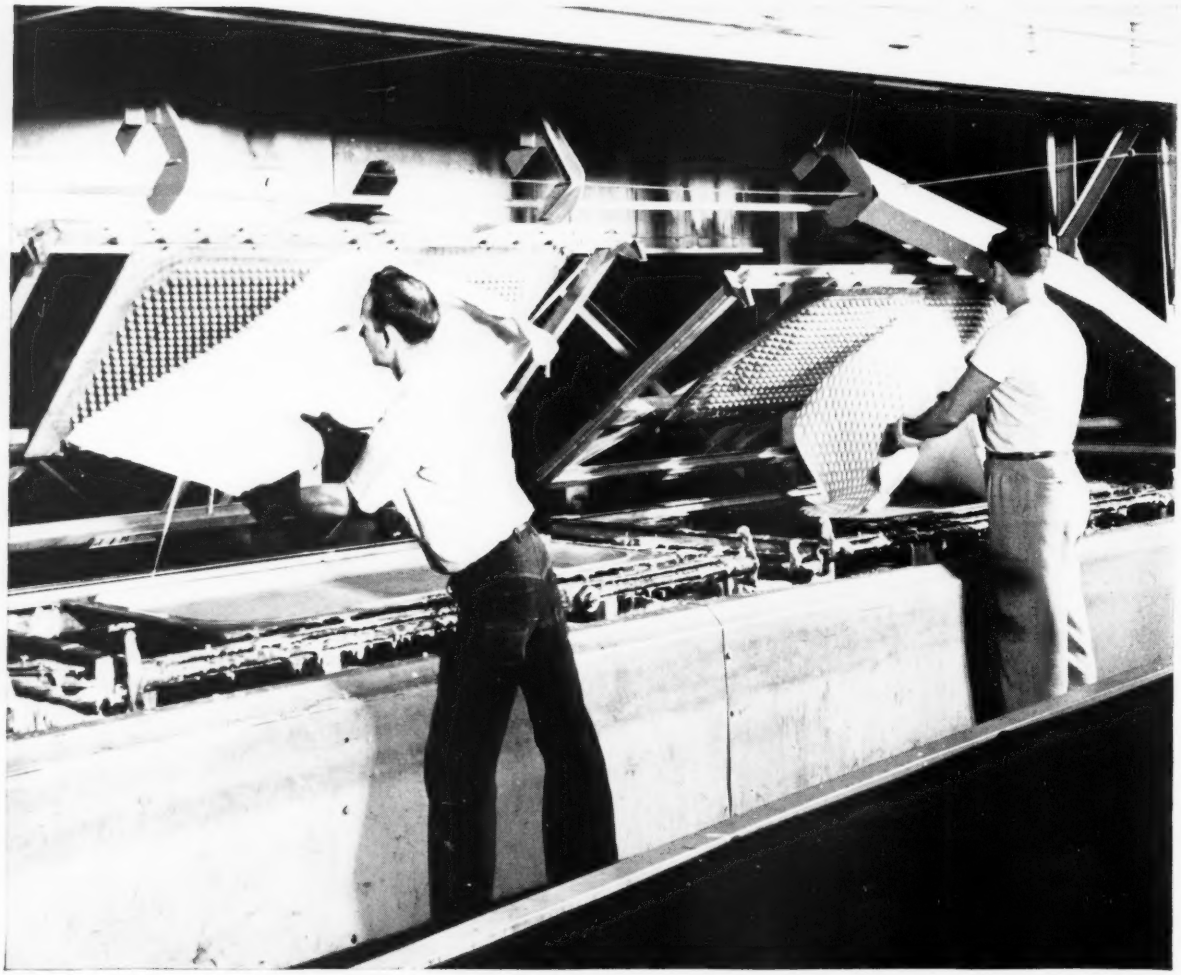
•Hi-Sil–T.M. Columbia-Southern Chemical Corporation, Pittsburgh, Pa.

High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries



Both first and foam-most!

First and foremost choice of a number of manufacturers of foamed rubber products is one of two Goodyear latices–PLIOLITE LATEX 2104 or PLIOLITE LATEX 2105.

PLIOLITE LATEX 2104 is a "cold" polybutadiene latex which exhibits virtually no odor. This feature plus its high solids content and excellent mechanical stability make PLIOLITE LATEX 2104 extremely well-suited to the production of pillows, mattresses and other types of cushioning.

PLIOLITE LATEX 2105 is a "cold," high solids, butadiene/styrene latex. It, too, exhibits excellent mechanical stability with light color, high physical properties and low temperature flexibility–for advantageous use in foamed goods where very slight odor is permissible.

In addition to these latices, there are a number of other rubber and resin latices in the PLIOLITE family. Each can be used alone or in combination with the others to obtain specific properties in foam or any of the many applications for latex.

Details plus the latest *Tech Book Bulletins* on PLIOLITE LATEX are yours by writing to:

Goodyear, Chemical Division, Akron 16, Ohio

PLIOLITE
LATEX
water dispersion of synthetic rubber

CHEMICAL
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High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

What styrene resin for reinforcing synthetic rubber?

The charts reproduced at right represent just some of the reasons for reinforcing styrene rubber with PLIOLITE S-6B.

Besides its decided improvement of physical properties in general, PLIOLITE S-6B offers two other major benefits. First, it serves as a processing aid. And second, it functions as an indirect cost-cutter.

PLIOLITE S-6B works as a processing aid by acting as a plasticizer at elevated temperatures to provide smooth-running, easy-flowing stocks of reduced nerve. It also improves mold reproduction and minimizes warpage and shrinkage of extruded goods.

PLIOLITE S-6B helps cut costs by permitting lighter-weight stocks and/or the use of larger amounts of fillers. It also makes possible substantial economies in mixing, forming and curing, reduces rejects and permits easier work-away of cured scrap.

You'll also find a number of other advantages to compounding styrene rubber with PLIOLITE S-6B. Details plus the latest *Tech Book Bulletins* are yours by writing to:

Goodyear, Chemical Division, Akron 16, Ohio

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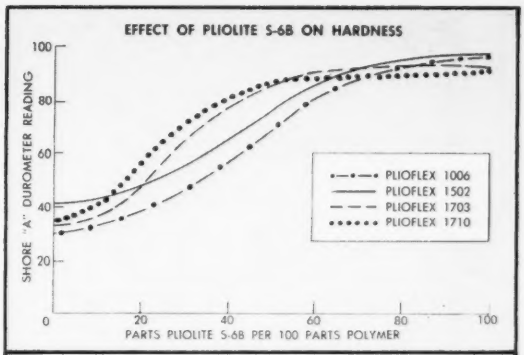
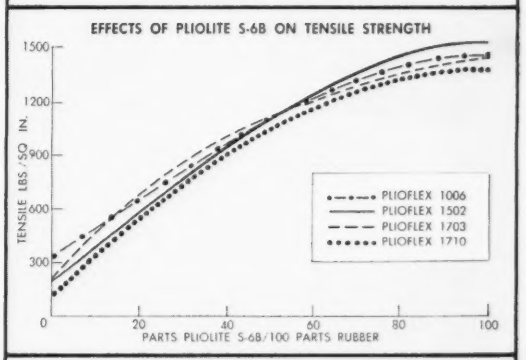
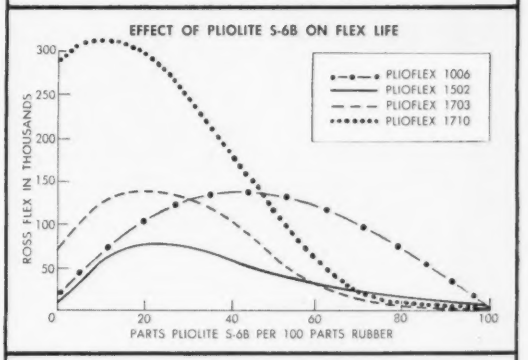
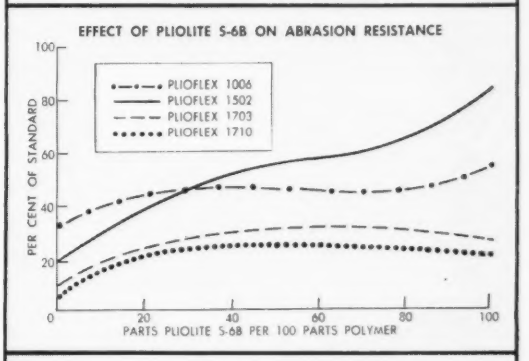
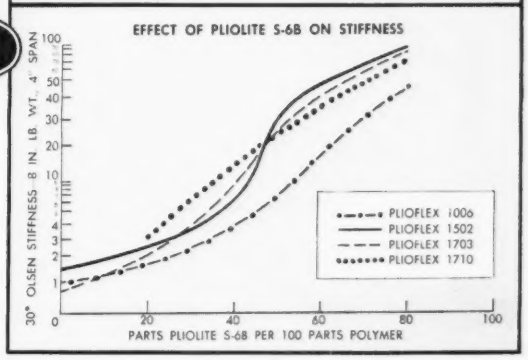
Pliolite, Plioflex—T.M.'s The Goodyear Tire & Rubber Company, Akron, Ohio










EFFECT OF PLIOLITE S-6B ON STIFFNESS
30° OLSEN STIFFNESS - 8 IN. LB. WT., 4" SPAN
PARTS PLIOLITE S-6B PER 100 PARTS POLYMER
PLIOFLEX 1006
PLIOFLEX 1502
PLIOFLEX 1703
PLIOFLEX 1710

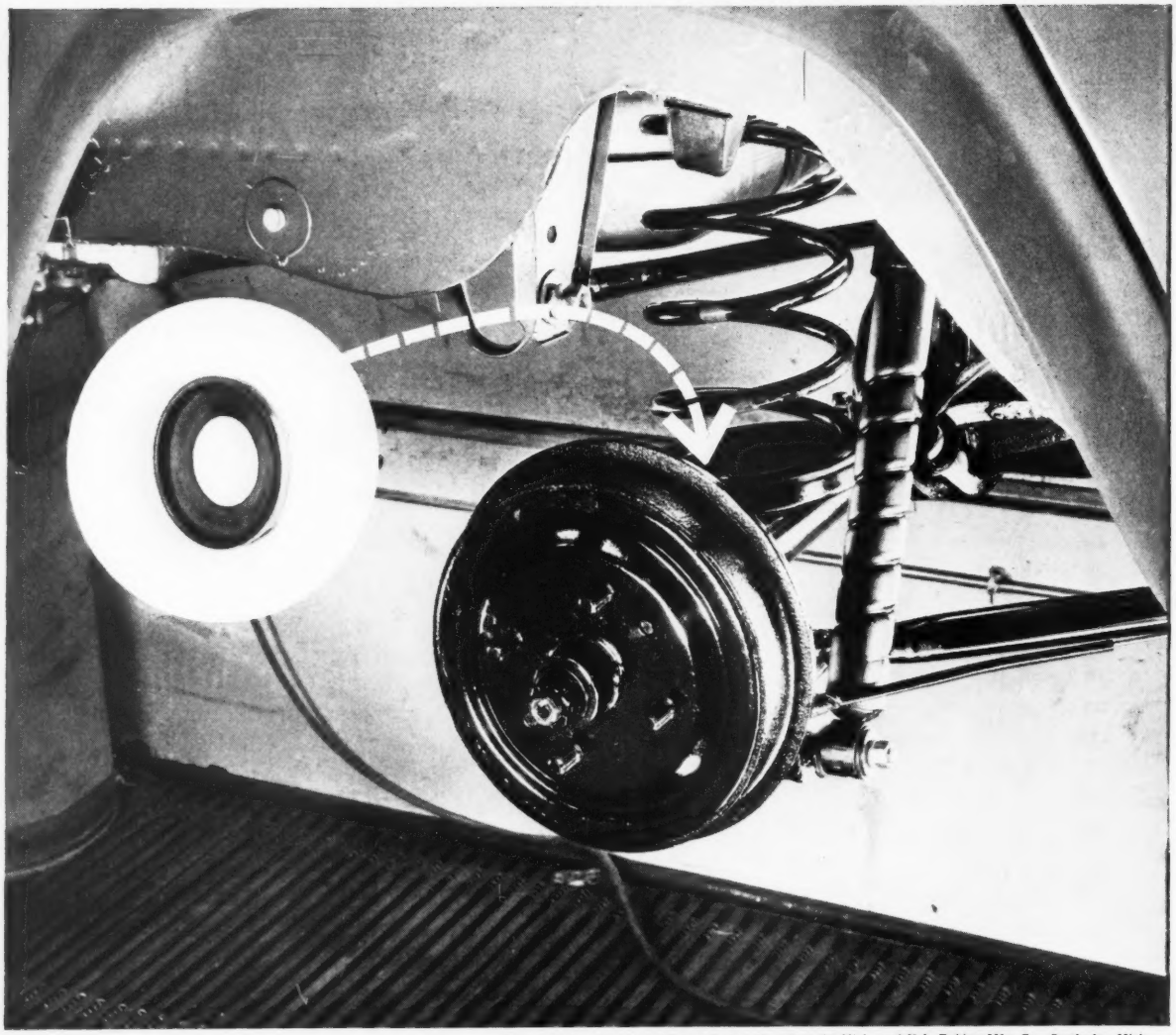


Photo courtesy American Motors Corporation, Detroit, Mich., and Yale Rubber Mfg. Co., Sandusky, Mich.

How to make "sealability" mean salability

If you're interested in making oil seals that will sell, then take two tips from the manufacturer whose product is pictured above. First, develop the simplest design that will do the job. And second, use a compound based on CHEMIGUM nitrile rubber.

CHEMIGUM was chosen for the outer axle shaft seal (shown above) for the following reasons: 1. Outstanding resistance to a range of oils and greases at temperatures up to 250°F. 2. Consistent uniformity. 3. Compatibility with other materials needed. 4. Excellent processability. 5. Physical properties exactly suited to the application.

Through his choice of CHEMIGUM coupled with careful design, this manufacturer has achieved outstanding sealing and performance at reasonable cost – a combination that really sells. How can CHEMIGUM help your ideas become effective realities? Find out by writing for details plus the latest *Tech Book Bulletins* to: Goodyear, Chemical Div., Akron 16, Ohio.

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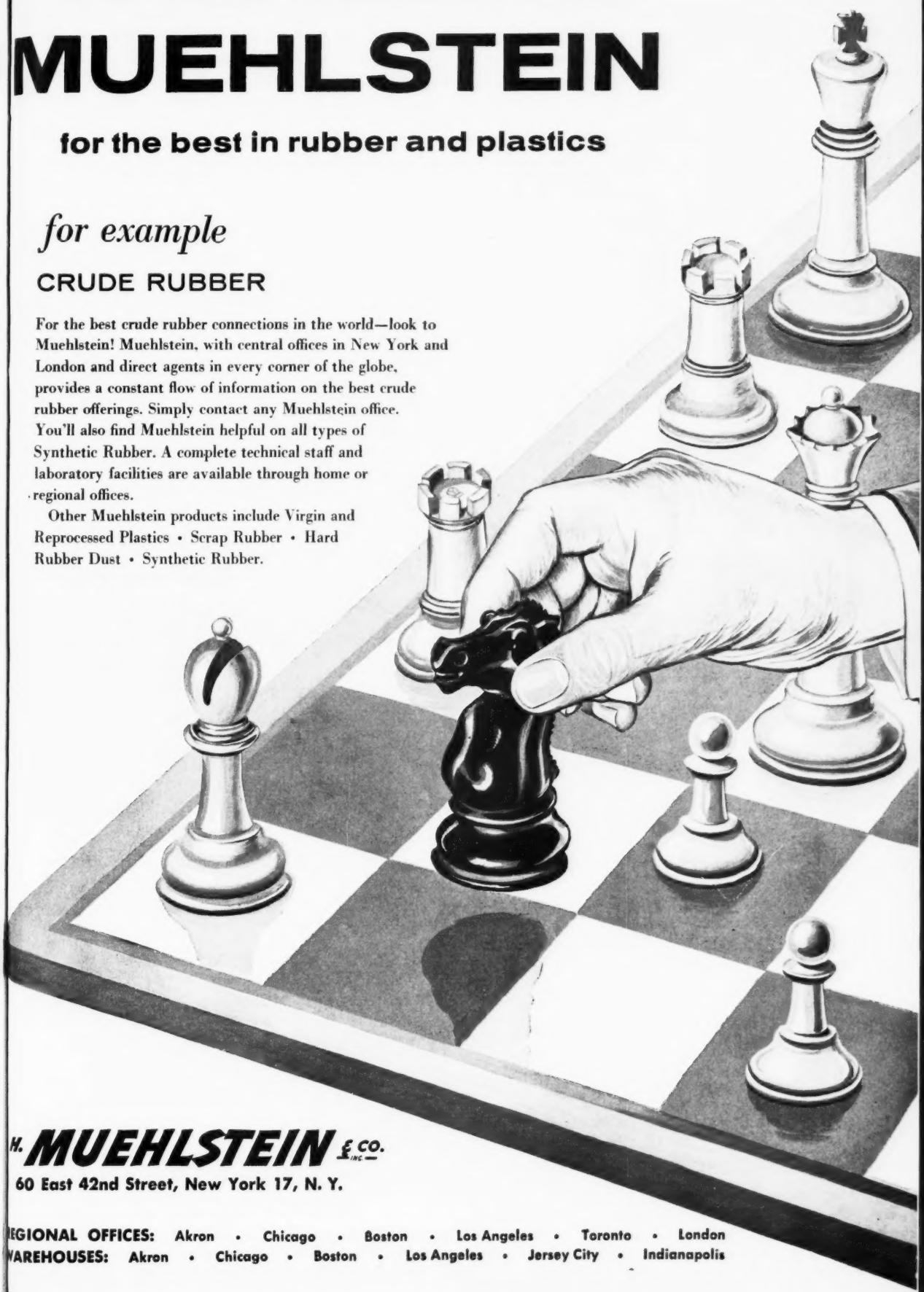

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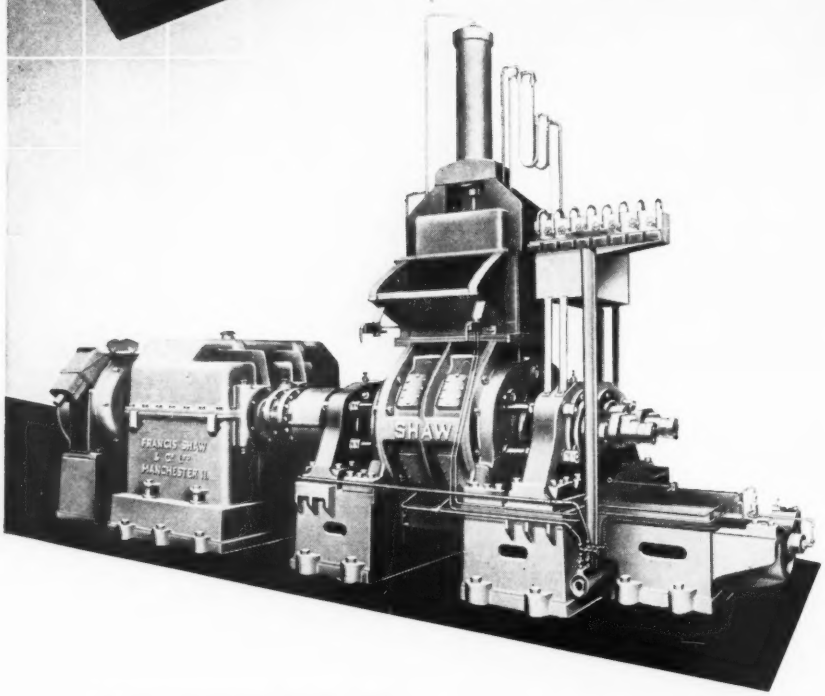

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Shell Chemical's newest Latex S-2105 has excellent uniformity, color and aging properties. It is ideal for latex foam, carpet backing adhesives and other applications where a high-solids latex is required.

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Synthetic Rubber Sales Division
P. O. Box 216, Torrance, California

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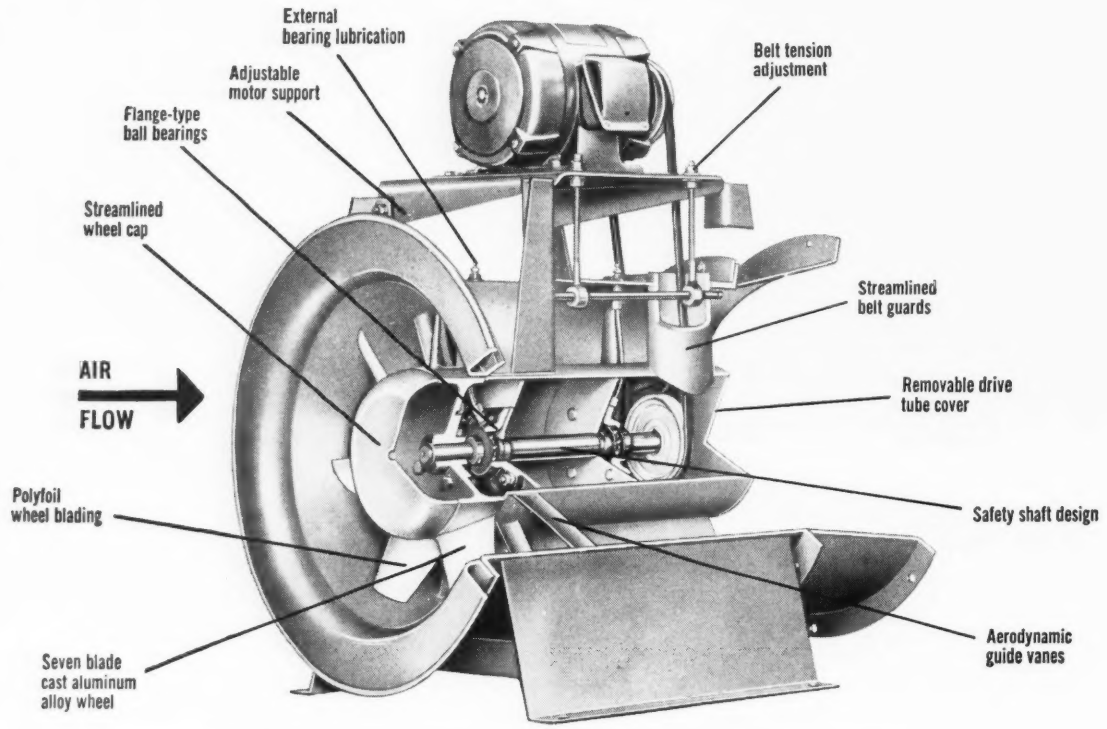
for Industrial air, fume, vapor handling jobs!



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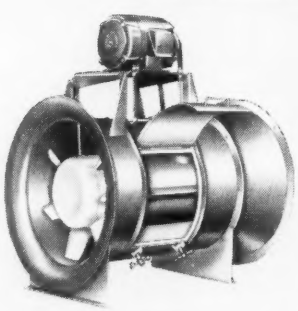

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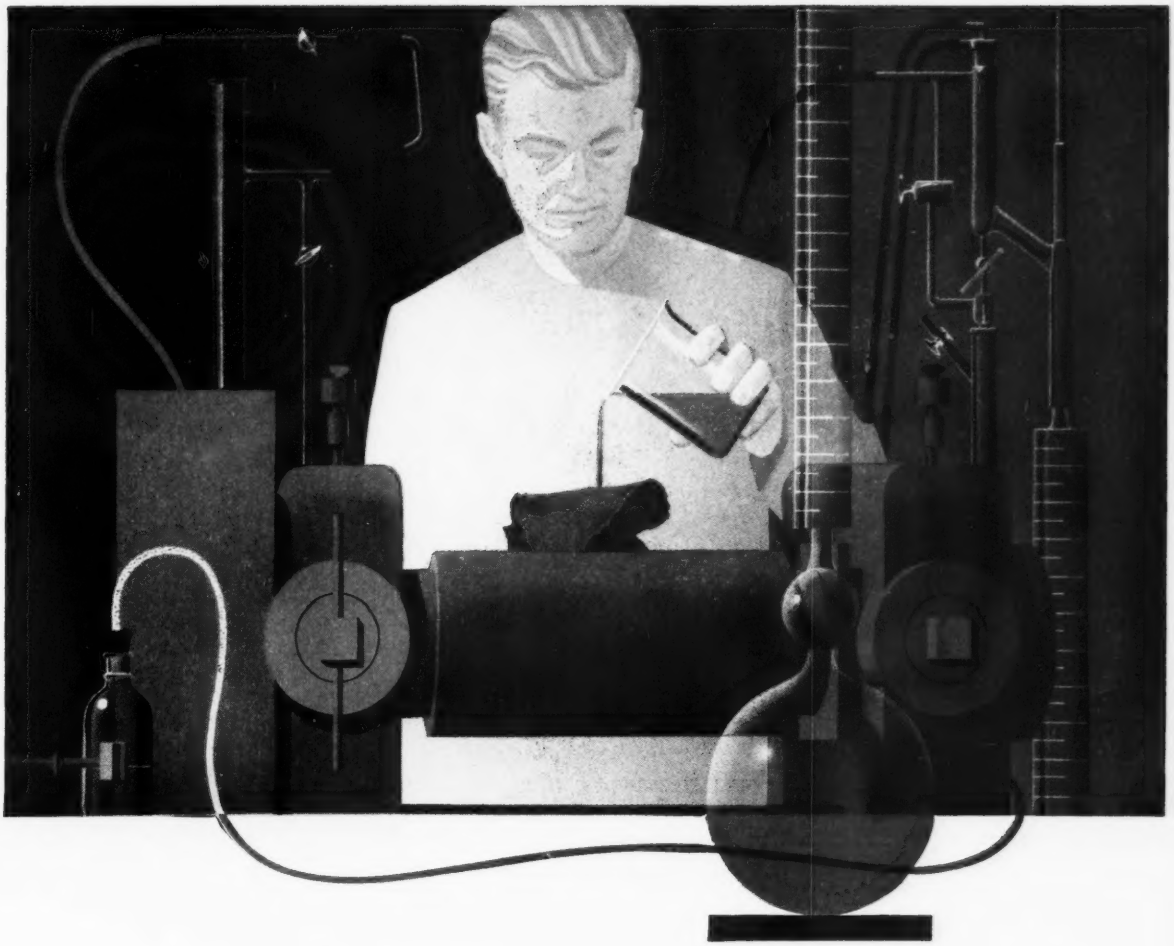

Our Technical Service Laboratory Will Help You Build Better Products With Neville Resins

If you are not already using Neville coumarone-indene resins in the manufacture of your rubber products, it will pay you to request the assistance of our Technical Service Laboratory. Our chemists will work with yours in choosing the exact grade to suit your need. Neville coumarone-indene resins are ideal extender-plasticizers. They aid processing and add tensile strength and durability to finished compounds. Write for details.

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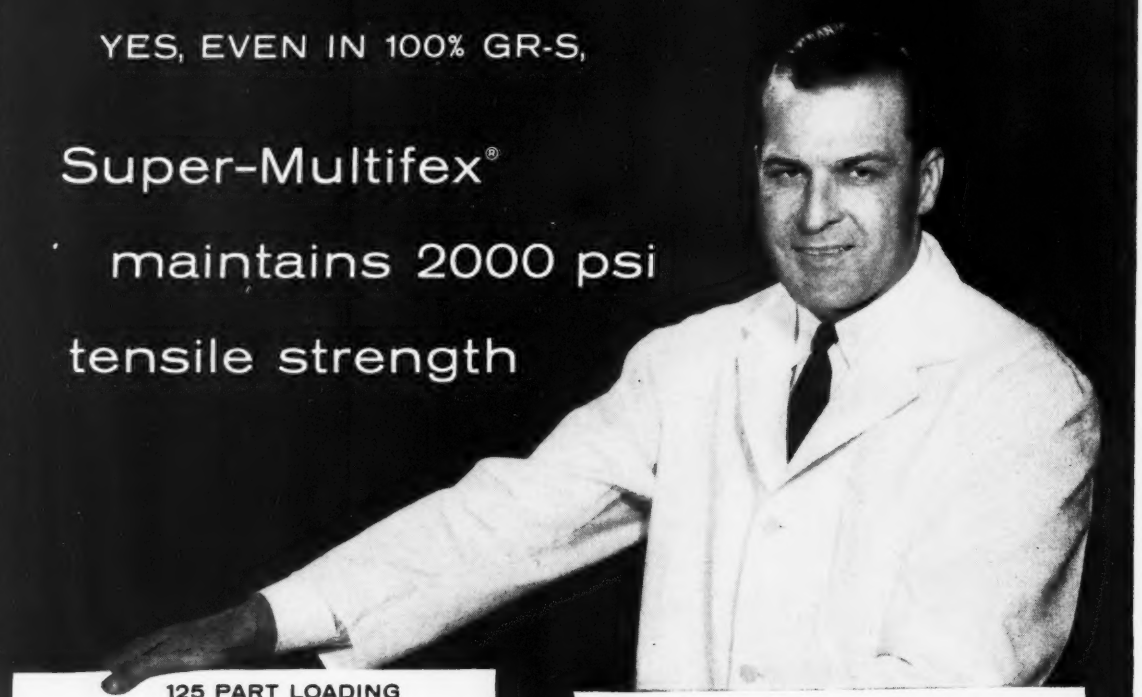

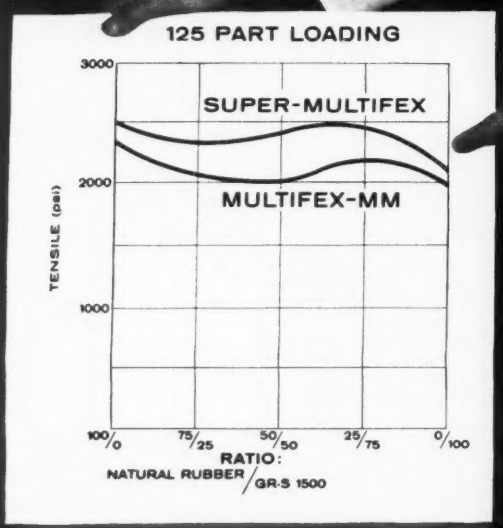

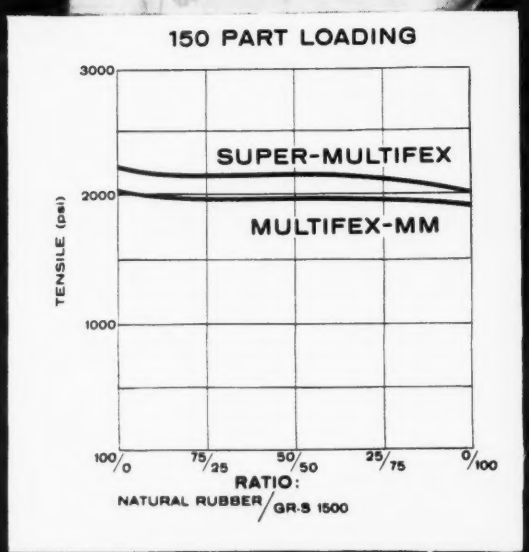

Now you can use DIAMOND Super-Multifex in your GR-S compounds—even in those with *no* natural rubber—and be sure you're getting at least 2000 psi tensile strength.

Contrast the performance of Super-Multifex and Multifex-MM® with the much lower tensiles normally obtained in compounds containing ground limestone.

DIAMOND's ultra-fine Super-Multifex (.03 micron) precipitated calcium carbonate has extremely uniform particles, coated to aid dispersion, mixing and processing.

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Try either Super-Multifex or Multifex-MM in your next batch to improve physical properties. Call your DIAMOND Representative today. He can supply information and technical help on these and other high-grade calcium carbonates. Or write DIAMOND ALKALI COMPANY, 300 Union Commerce Bldg., Cleveland 14, Ohio.

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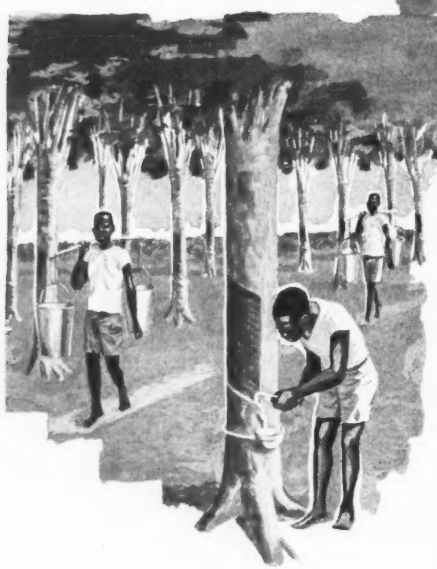

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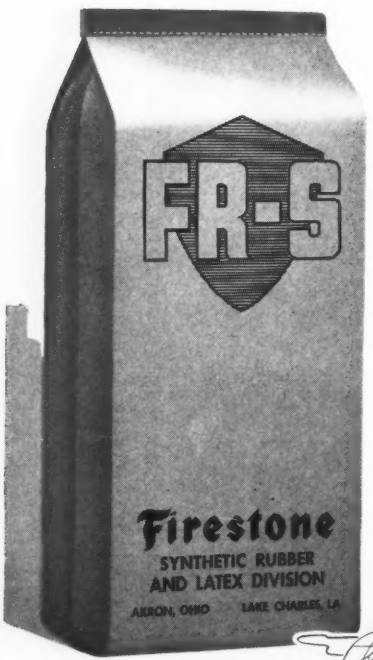

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Firestone

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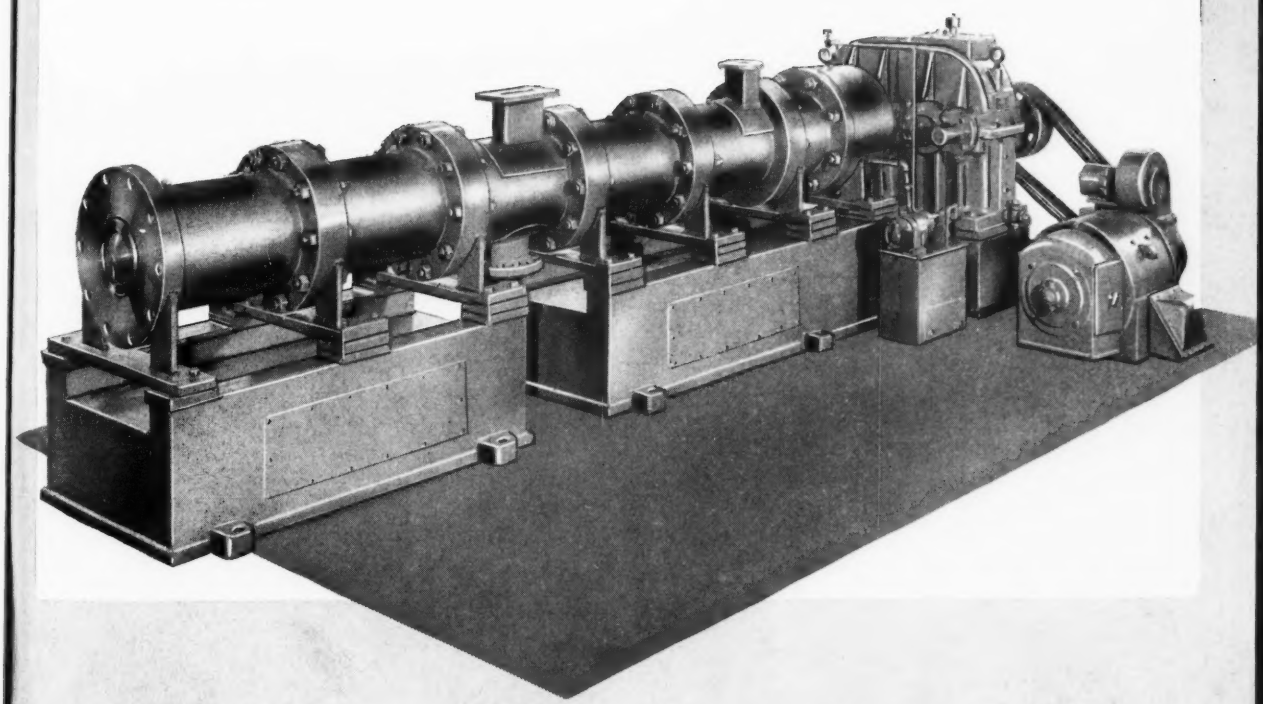
Specials... THAT'S US



The 8" extruder illustrated fits into a special processing line. Custom designed for a large chemical company, the extruder had to be designed to coordinate with existing processing, blending and mixing facilities.

Extruders for standard operations can be off-the-shelf models but new processes, new products, new ideas require specific designs. For example, in the processing of polyethylene, we developed special extruders for simultaneous hot and cold feeding. In the fields of foamed plastics, polystyrene, polyethylene, the vinyls, we have designed many individual extruders for processing, blending, reclaiming and devolatilizing.

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Ameripol Code	REMARKS	APPLICATIONS
HOT POLYMERS		
1000	General purpose hot rubber adaptable to most black products or products where color is unimportant.	Tires, molded and extruded mechanical goods, and many general purpose applications.
1001	More resistant to staining and discoloring than 1002.	Tires, molded and extruded mechanical goods, shoe soles and heels.
1002	Higher tensile and lower modulus in cured compounds than 1000 or 1001. Tends to slower curing, thus some adjustment might be necessary.	Tires, molded and extruded mechanical goods.
1006	Improved non-discoloring and non-staining polymer.	Light colored and white products such as white side-wall tires, shoe soles, floor tile, toys, etc.
1007	A glue-acid coagulated staining polymer with relatively low water absorption, low ash, and improved electrical properties.	Wire and cable insulation, electrical matting, gaskets, hard rubber products, etc.
1009	Non-staining cross-linked polymer. Use of small quantities with other type polymers effectively reduces shrinkage and die-swell in calender and extrusion operations.	Wherever control of shrinkage is important—footwear, wire and cable insulation, calendered sheet goods, camelback, soles and heels.
COLD NON-OIL POLYMERS		
1500	General purpose cold rubber where color and staining is unimportant.	Tires, camelback, molded and extruded mechanical goods.
1501	Same as 1500 except slightly staining stabilizer which permits use in some darker colored products.	Tires, molded mechanical goods.
1502	Relatively non-discoloring and non-staining cold rubber.	Light colored and white products such as white sidewall tires, white and light colored mechanical goods, floor tile, hospital sheeting, toys, shoe soles and heels.
COLD OIL-EXTENDED POLYMERS		
1703	General purpose relatively non-discoloring, non-staining polymer containing 25 parts oil. Presence of naphthenic oil may affect stain characteristics.	Light colored and white products—tires, mechanical goods, floor tile, hospital sheeting, toys, shoe soles and heels.
1705	General purpose polymer containing 25 parts aromatic oil for use where staining, discoloring is unimportant.	Tires, camelback, molded and extruded mechanical goods.
1707	Similar to 1703 but for 37.5 parts naphthenic oil, and emulsified with rosin soap rather than mixed soaps.	Tires, camelback, shoe soles and heels, molded and extruded mechanical goods.
1708	Relatively non-discoloring, non-staining polymer containing 37.5 parts naphthenic oil. Glue acid coagulation provides lower water absorption and improved electrical properties.	Wire and cable insulation, athletic goods, coated fabrics, molded and extruded mechanical goods.
1710	Similar to 1705 except for 37.5 parts of an aromatic oil.	Tires, camelback, molded and extruded goods.
1712	General purpose oil extended for use where color is unimportant. 37.5 parts high aromatic oil.	Tires, camelback, molded and extruded mechanical goods, wire and cable insulation.

selection guide to *Ameripol* man-made rubber

Ameripol man-made rubber is a preferred material for conveyor and drive belts, rolls, extrusions, molded goods, and many other industrial products. Ameripol is superior to natural rubber in resistance to wear, water, and chemicals. Superior aging properties can be provided by compounding techniques.

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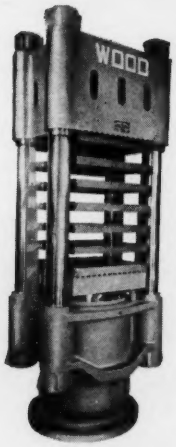
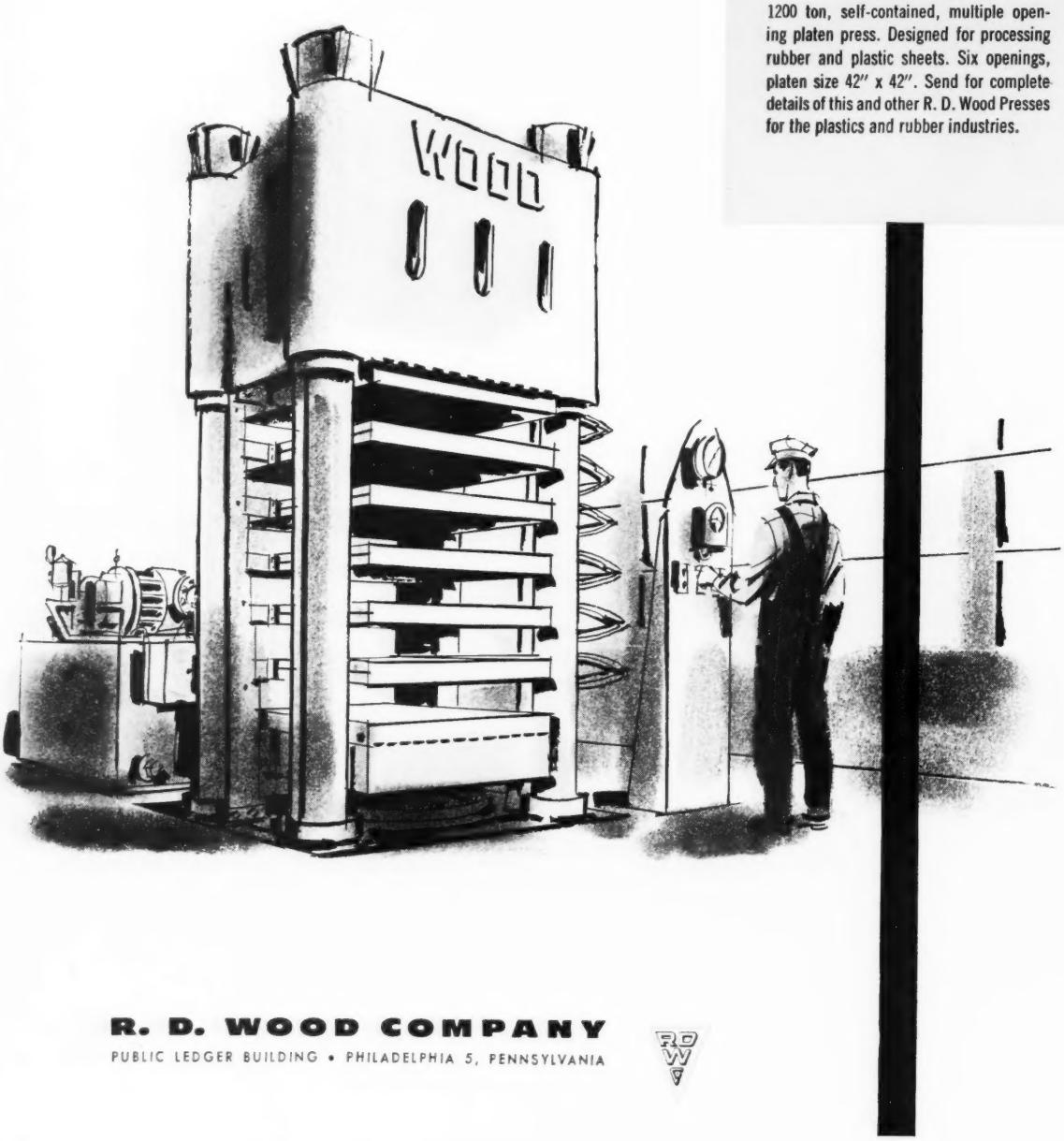
There's always a job for a Wood Press... and a Wood Press to do the job

When you want a production shortcut—or downtime and costs need cutting—there's a job for a Wood Press. And in almost every type of plastics or rubber operation, there's a Wood Press to do the job. R. D. Wood builds presses for such jobs as molding, curing, laminating, polishing and processing—besides designing and constructing others for special work. All have three things in common: sound design, carefully selected materials, conscientious workmanship. As a result, R. D. Wood Presses consistently deliver the utmost in smooth, dependable performance; fast, economical production; trouble-free operation. Write for catalog and engineering information—without obligation.



1200 ton, self-contained, multiple opening platen press. Designed for processing rubber and plastic sheets. Six openings, platen size 42" x 42". Send for complete details of this and other R. D. Wood Presses for the plastics and rubber industries.



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Another first from Monsanto

SULFASAN* R...a non-discoloring vulcanizing agent—for part replacement of curing agents—that makes possible bloom-free nitrile and butyl stocks with good physical properties

SULFASAN R—quite simple to use and quite unique. Created by Monsanto's Rubber Chemicals Department, this vulcanizing agent is a sure-fire remedy for bloom on nitrile and butyl formulations. And more than this, Sulfasan R gives a high degree of safety from scorch and excellent aging characteristics.

But most significant today, rubber shops turning out Buna N and butyl rubber mechanical goods are finding that Sulfasan R is a tremendous boon. While bloom seldom affects the rubber part's performance, it does hurt its appearance. When a nice, smooth gloss on dispensing hose, cable insulation, appliance parts, gloves and aprons contributes to the appearance of quality—a nonblooming composition is a must. Use of Sulfasan R can stop—right now—customer complaints about "dullness."

Sulfasan R is a Monsanto development; chemically, it is 4,4' -dithiodimorpholine. It is added in the range of 1 to 2 parts on the formulation; conventional vulcanizing agents are cut back—usually by the same amount as the Sulfasan R added. This addition of Sulfasan R imparts the following benefits:

Freedom from bloom
Excellent aging
Resistance to scorch

And Sulfasan R is non-discoloring; it can be used in white and light-colored stocks.

For more information on Sulfasan R and guidance on formulating, write or call Monsanto.

Accelerators—*For fast, slow, and regulated rates of safe cure.*

Antioxidants—*For maximum oxidation resistance.*

Plasticizers

Specialty Processing Materials

MONSANTO CHEMICAL COMPANY
Rubber Chemicals Department
Telephone: HEmlock 4-1921, Akron 11, Ohio

This stock bloomed: 100 parts nitrile rubber, 5 zinc oxide, 1.0 stearic acid, 40.0 FEF black, 3.5 Thiurad.*

No bloom. Stock same as above except Thiurad reduced to 1.5 parts... and 1.5 parts of Sulfasan R added.

*Reg. U. S. Pat. Off.

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Whether you are working with GR-S, Buna-N, natural rubber or Neoprene... producing compounded stocks or solvent-type adhesives... Durez resins may help to solve your problems of performance and costs. Let us send you the current edition of our bulletin on Resins for the Rubber Industry.

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HE WILL HELP YOU MAINTAIN EFFICIENCY —

and help reduce downtime. Backed by the original manufacturer's facilities, he is in a position to recommend recently improved parts and materials — give you up-to-date rebuilding that assures "good as new" Banbury mixer performance.

HE CAN ADVISE ON IMPROVING OPERATIONS —

because he has built up a storehouse of "know-how" through his association with Farrel-Birmingham and his many contacts with industry. He can also advise on improved integration of the Banbury mixer with your production system.

HE CAN MAKE PREVENTIVE REPAIRS —

to keep production flowing, and perhaps avert, or at least postpone, the need for major overhaul and parts replacement.

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FB-1118

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accelerator *for safe processing fast curing compounds of all types*

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R. T. Vanderbilt Co., INC.

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HOT or COLD!

whichever you use in your manufacturing processes

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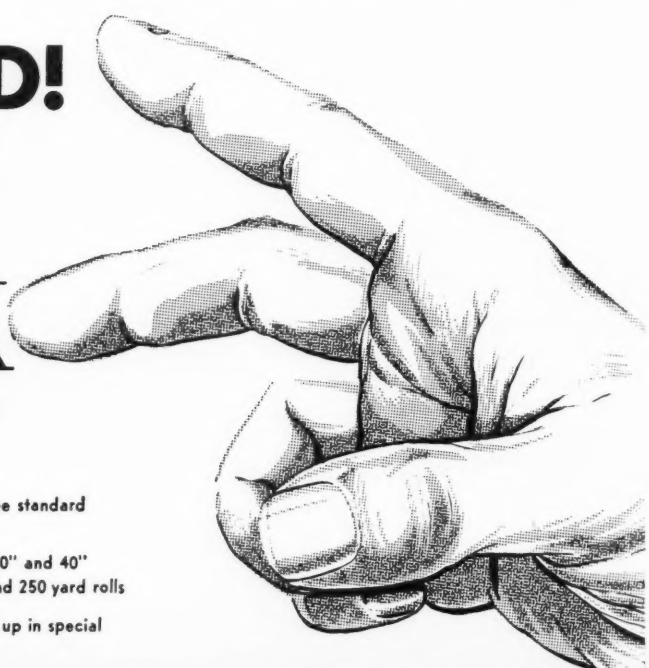
RUBBER HOLLAND

is the correct solution!



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- ★ clean peeling and non-flaking
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- ★ comes in three standard qualities
- ★ available in 20" and 40" widths, 100 and 250 yard rolls
- ★ can be made up in special size rolls

THE HOLLISTON MILLS, INC., *NORWOOD, MASS.*

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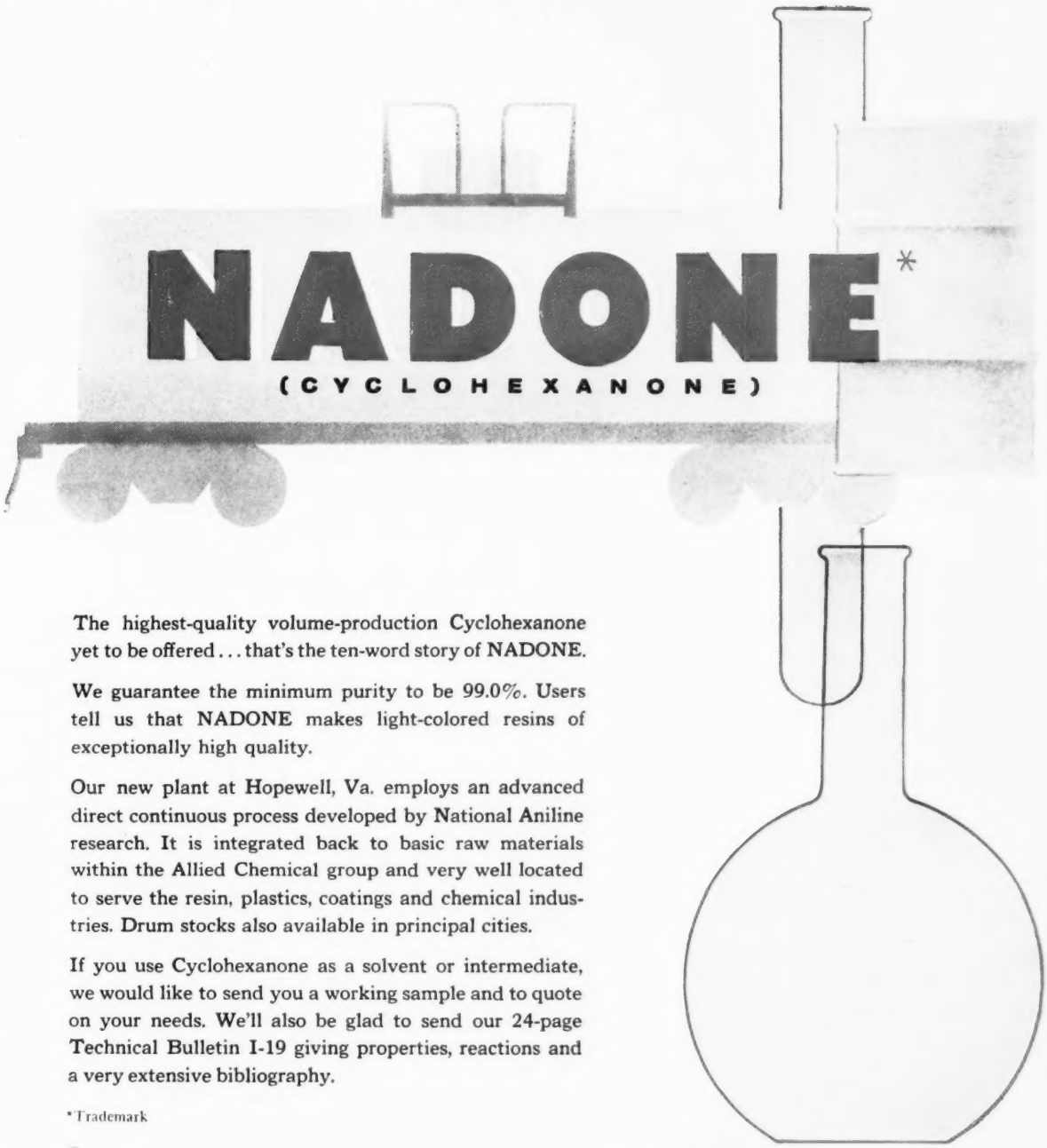

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(CYCLOHEXANONE)

The highest-quality volume-production Cyclohexanone yet to be offered . . . that's the ten-word story of NADONE.

We guarantee the minimum purity to be 99.0%. Users tell us that NADONE makes light-colored resins of exceptionally high quality.

Our new plant at Hopewell, Va. employs an advanced direct continuous process developed by National Aniline research. It is integrated back to basic raw materials within the Allied Chemical group and very well located to serve the resin, plastics, coatings and chemical industries. Drum stocks also available in principal cities.

If you use Cyclohexanone as a solvent or intermediate, we would like to send you a working sample and to quote on your needs. We'll also be glad to send our 24-page Technical Bulletin I-19 giving properties, reactions and a very extensive bibliography.

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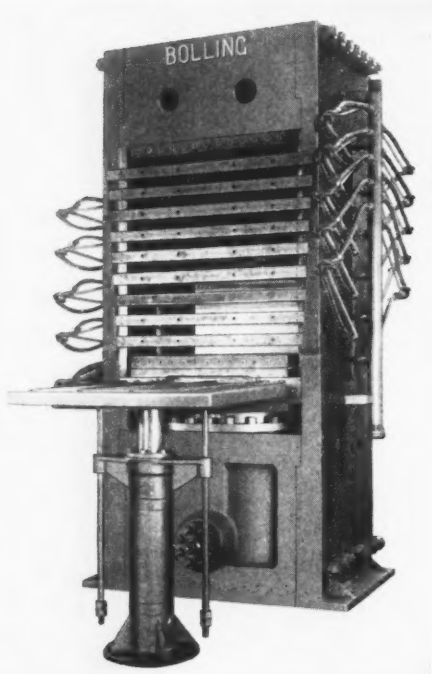
FOR THE ULTIMATE IN PRECISION MOLDING

choose a press by

STEWART BOLLING

deflection-resisting • rugged • negligible maintenance



10-deck, 1000-ton, 42″ x 42″ sole press

Meet close tolerances with a Bolling slabside press. Bolling slabside design places strength where needed in order to avoid deflection and assure the highest percentage of usable production. Bolling slabside presses are available from 20″x20″ through 48″x48″. The tonnage span is from 100 to 1250. Bolling also designs and builds a complete range of 4-bolt presses, full- and semi-ring presses, hydraulic pumping units and lift tables.

Stewart Bolling also builds a complete line of intensive mixers, mills and calenders for production and laboratory requirements.

Write for descriptive literature W-5.

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HYDRAULIC PRESSES • PUMP UNITS • BALE SLITTERS • SPEED-REDUCERS

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Vulcanized Oil

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GRADES

OLDEST AND LARGEST MANUFACTURERS
OF Factice VULCANIZED OIL
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LEADERS IN THE FIELD
For
RESEARCH and
MANUFACTURING
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HOW THE SILICONES MAN HELPED...

Build a Gyro for Straight Shooting!

Accuracy that could hit a fly from a screaming roller coaster . . . so rugged that it can be used to drive nails without impairing its operation. That's the "impossible" fire control gyro built by Minneapolis Honeywell, Aeronautical Division. Known as the HIG-5 (Hermetic Integrating Gyro), lightweight and small enough to hold in the palm of your hand, it supplies the "sense of balance" necessary at supersonic speeds.

Operating in a viscous fluid under wide limits of temperature and pressure, seals can be no less than perfect. What material was used? "O" rings of UNION CARBIDE Silicone Rubber.

Fabricated by Moxness Products Company, Racine, Wisconsin, these "O" rings were tested from −65 to +200 deg. F., at simulated pressures from ground level to operational altitudes. Under such rigid tests, UNION CARBIDE Silicone Rubber showed outstanding sealing qualities and resistance to compression set.

This is another example of how the UNION CARBIDE Silicones Man has helped solve an "impossible" problem. A booklet—"Look to UNION CARBIDE for Silicones"—describes silicone rubber and many other silicone products. Write Dept. RW-5 today. Silicones Division, Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.

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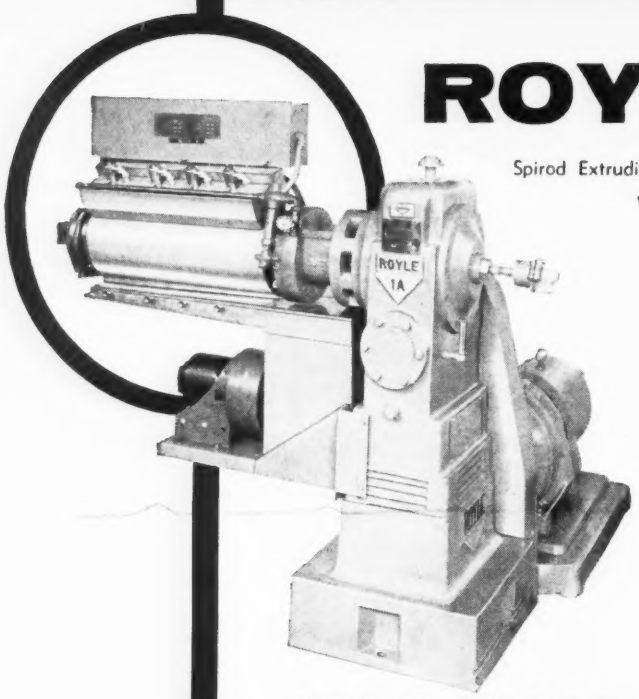
SILICONES

The term "Union Carbide" is a registered trade-mark of UCC.

In Canada: Linde Air Products Company, Division of Union Carbide Canada Limited, Toronto.

ROYLE

1A (2½" cylinder bore)



Spirod Extruding Machine with electric heating and high velocity evaporative cooling. An all-purpose extruding machine for processing rubber and plastics.
Available in sizes 1⅛" through 12" cylinder bore.

Strainers, Cooling Troughs, Light Wire and Cable Capstans, Motorized Take-ups, Temperature Control Units.

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Compensation—straight commission basis, no advances, and if your products have a potential that would interest us, we would be willing to spend within reasonable limits whatever is necessary to develop the market.

Financial and business references will be supplied on request.

A reply to this advertisement will be acknowledged and treated in confidence.

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2nd Edition

This new issue gives systematic classification of more than 2,000 chemicals and other raw materials, as well as machinery for the Rubber Industry. Every product has a short description, and the name and address of the supplier of everyone is given.

More than 200 suppliers all over the world are included, which makes the Handbook most useful for prospective purchasers.

Also included are worthwhile tables and other information for Rubber Technicians and Subject Index for Raw Materials and Machinery.

Printed in English and Swedish, 224 pages.

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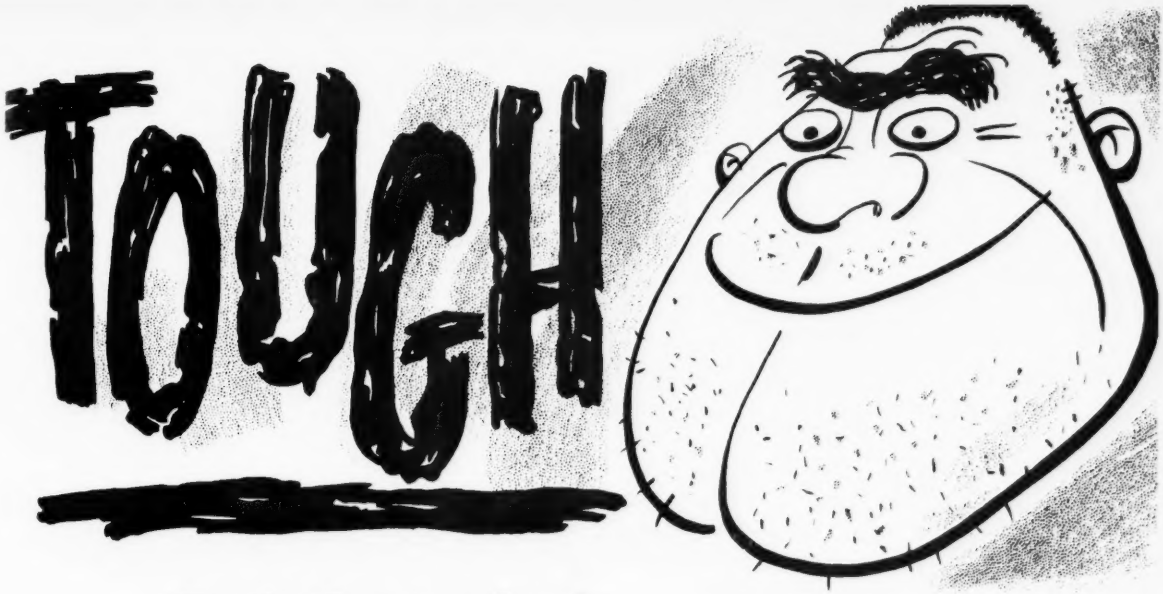

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Reinforcing High Styrene Resin

the perfect resin for hardness, toughness, tear-strength and increased modulus

- Greater Uniformity, Lighter, Brighter Colors
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Marbon "8000-A" resin fluxes rapidly at lower temperatures (165-175 degrees F.) for improved dispersion, shorter mixing cycles, faster heat-plasticizing action with lowered power demand. A superior-processing resin with all the reinforcing properties of Marbon 8000. Especially suitable for OPEN MILL mixing under marginal heat conditions.

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MARBON . . . . *It BLENDS as it STRENGTHENS as it IMPROVES*

TEXUS proudly announces the development of a non-volatile pale naphthenic oil... used exclusively in new improved SYNPOLS.

Now! Oil-extended FAST, HIGH-

Here for the first time are *light-colored*, non-volatile oil-extended polymers in the popular 1703, 1707 and 1708 types. These **SYNPOLS** are completely interchangeable with current dark-colored types of the same number. Ask your **TEXUS** representative to show you this comparison case.

Polymers combining TEMPERATURE PROCESSING with LIGHT COLOR

A new, non-volatile pale oil that makes possible *light-colored* oil-extended polymers that are *completely interchangeable* in rubber formulations with current dark-colored rubbers of the same numbers... this development is the latest and most significant in a series of improvements in synthetic rubber production by Texas-U.S. Chemical Company.

Used *exclusively* in TEXUS SYNPOL oil-extended polymers, this unique pale oil is specially refined from carefully selected naphthenic crudes and is comparable in volatility to the standard dark extending oils. It eliminates the processing problems caused by the volatility of currently used light-colored oils. Thus TEXUS, alone, is able to offer, for the first time in the 1700 series, *light-colored* butadiene-styrene polymers which can be processed at *high temperatures,* permitting fast Banbury and mill mixing. Furthermore, they are non-migrating and their vulcanizates retain their light colors even after extreme and prolonged exposure to sunlight and heat.

SIMPLIFIES PROCESSING PROBLEMS

Extensive factory tests and manufacturing usage *minimize* your needs for time-consuming testing and compound adjustment when adopting these completely interchangeable light-colored SYNPOL oil-extended polymers. Their use eliminates double inventory—one grade for dark products, another for products in which light or pastel colors are more important than fast-processing qualities. These TEXUS SYNPOLS give you *both* advantages!

Here are the three light-colored SYNPOLS, made with the new TEXUS non-volatile pale oil, which offer you unprecedented opportunities for the economical manufacture of many *new* light-stable, white, bright and pastel-colored rubber products:

IMPROVED SYNPOL 1703

A new 25-parts naphthenic pale non-volatile oil-extended polymer, completely interchangeable with any other 1703. Its light color makes possible lighter shades and brighter colors in rubber toys, floor tile and shoe soles; identifying colors in belting and other mechanical rubber goods...and a host of colorful new products.

IMPROVED SYNPOL 1707

A new 37.5-parts naphthenic pale non-volatile oil-extended polymer, and the only light-colored rubber of this grade on the market today. In addition to replacing other 1707 polymers, it provides an economical substitute, in whole or in part, for 1500 and 1551 types.

IMPROVED SYNPOL 1708

A new 37.5-parts naphthenic pale non-volatile oil-extended polymer made with a glue-acid coagulant to assure low ash content and low moisture-absorption characteristics. This, combined with its light color, makes it an excellent choice for wire insulation—particularly where color coding is important. Based on an all-fatty-acid emulsifier, this general-purpose oil-extended polymer provides an economical replacement for grades 1000, 1001, 1006 and 1061 in a wide variety of light-colored products.

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Moppet chooses TITANOX* for hiding power . . .

. . . and you will prefer these white pigments—whether your plastic or rubber products are in sheet or other form.

Even with very low pigment content, you can attain remarkable effects in whites and pastels with one or more of these leading white pigments such as TITANOX-RA. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; Atlanta 5; Boston 6; Chicago 3; Cleveland 15; Houston 2; Los Angeles 22; Philadelphia 3; Pittsburgh 12; Portland 14, Ore.; San Francisco 7. In Canada: Canadian Titanium Pigments Limited, Montreal 2; Toronto 1; Vancouver 2.

TITANIUM PIGMENT CORPORATION

Subsidiary of NATIONAL LEAD COMPANY

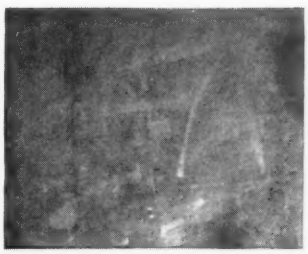
4790

*TITANOX is a registered trademark for the full line of titanium pigments offered by Titanium Pigment Corporation.

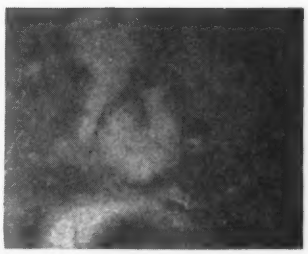
BLOOM REDUCTION

A-SLIGHT BLOOM
(GR-S Cable Jacket Compound)

B-**NO BLOOM**



C-HEAVY BLOOM
(Nitrile Rubber—Sulfurless Cure)



D-SLIGHT BLOOM

E-**NO BLOOM**

with blends of 'SHARPLES' brand Ultra Accelerators

These photographs of rubber samples illustrate surface bloom one year after curing . . .

. . . the tests indicate that, in these two cases, blends of Ethyl and Methyl ultra accelerators will produce less bloom than either one used alone.

Illustrations A and B show the effect of using a blend of Ethyl and Methyl Ziram instead of straight Methyl Ziram in a GR-S Cable Jacket Compound. Photo B shows that bloom has been greatly reduced. The accelerator ratios used were as follows:

	A	B
Sulfur	2.0	2.0
MBTS	2.0	2.0
SA-57 (Methyl Ziram)	1.5	0.7
SA-67 (Ethyl Ziram)	—	0.8

Illustrations C and D show the bloom resulting when either Methyl Thiram or Ethyl Thiram is used alone in a Nitrile Rubber-Sulfurless Cure compound. Photo E shows that bloom has been greatly reduced by using equal parts of Methyl and Ethyl Thiram. The ratios used were as follows:

	C	D	E
SA-52 (Methyl Thiram)	3.0	—	1.5
SA-62 (Ethyl Thiram)	—	3.0	1.5

Blends of 'Sharples' brand Ultra Accelerators may be helpful in reducing bloom in your formulations. Technical Report S-122 and samples sent on request.

Pennsalt Chemicals

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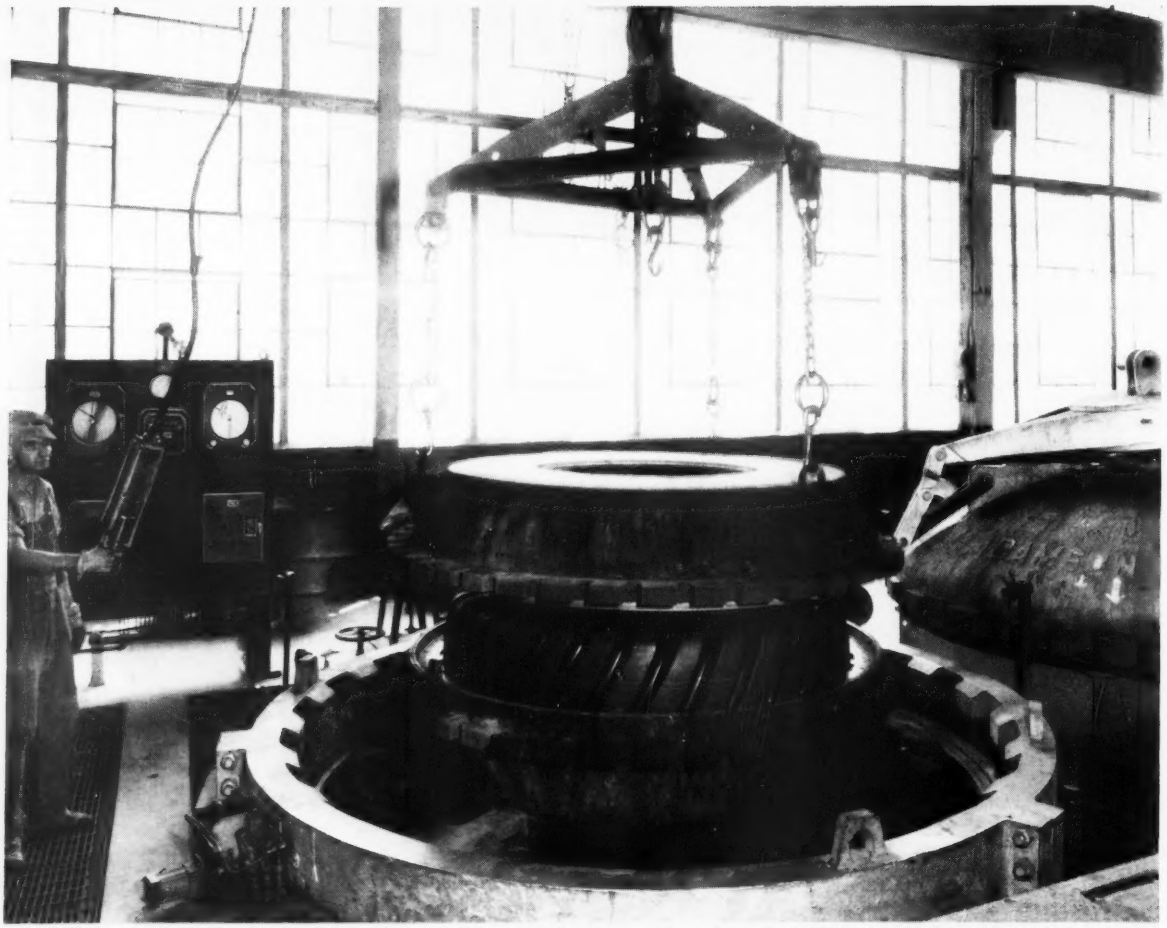

Taylor-controlled pot-heaters for Earthmover tires at Topeka, Kansas, plant of Goodyear Tire & Rubber Co. of Kansas, Inc.

Goodyear's tougher with Taylor

GOODYEAR "Earthmovers" are tougher because of Taylor precision controls on their pot-heaters. That's important because these 1600-lb. tires must carry mammoth loads and travel at speeds unknown to old-fashioned earth-moving equipment.

Goodyear officials say: "Properly controlled cure of Earthmover tires has first preference in the design of equipment." This meant ±1 degree in temperature . . . this meant ±1% in time . . . this meant Taylor Control Systems for fully automatic timing and temperature.

A Taylor FULSCOPE* Temperature Controller regulates the temperature. The complete cure is precision-timed by two Taylor FLEX-O-TIMERS*—a sequence timer for a range from two to 192 minutes and a cure timer having a range from 18 to 1,440 minutes.

THIS FULLY AUTOMATIC TIMING MEANS:

1. Improved tire quality—the automatic cure cycles *are uniform.*

2. Improved plant efficiency—automatic cure timing permits *closer scheduling of heats,* reduces idle time of equipment and operators.

3. Reduced processing costs—there's *no need for a "steam-tender"* to time curing stages.

The man to suggest what Taylor Control Systems can mean in your plant is your Taylor Field Engineer. Or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

*Reg. U.S. Pat. Off.

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It's no trick to get the right

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There's no magic about it, but it does take practice and years of know-how to produce the best rubber compounds for specific uses. Phillips Chemical Company has the experience . . . plus extensive modern research facilities . . . to help rubber products manufacturers.

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Call on us for practical, dollars-and-cents advice . . . on processing and production . . . on any question involving rubber.

Phillips 66

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COLD	PHILPRENE 1500 PHILPRENE 1502 PHILPRENE 1503	PHILPRENE 1601 PHILPRENE 1605
COLD OIL	PHILPRENE 1703 PHILPRENE 1706 PHILPRENE 1708 PHILPRENE 1712	PHILPRENE 1803

*A trademark

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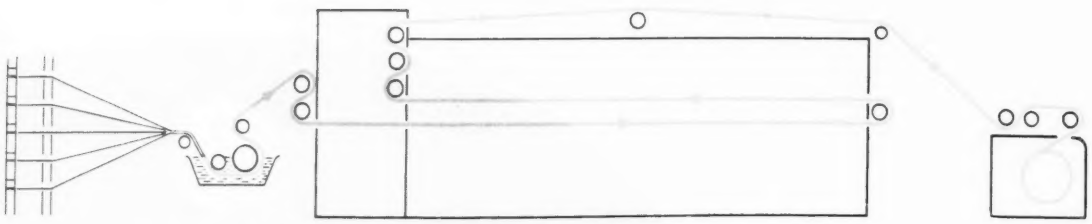

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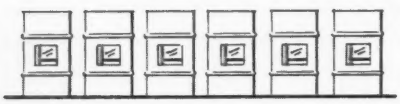
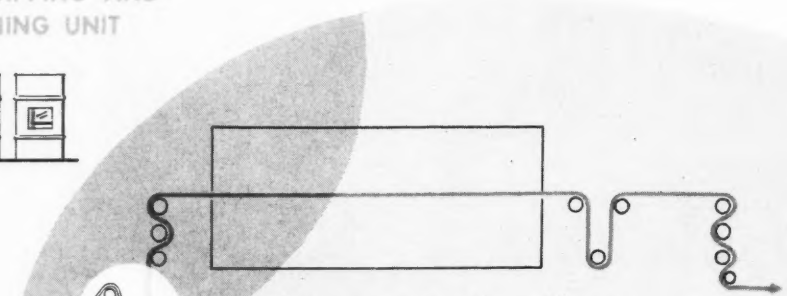
HOT-STRETCHING UNIT





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AND HOT-STRETCHING UNIT

MULTI-STAGE FABRIC DIPPING
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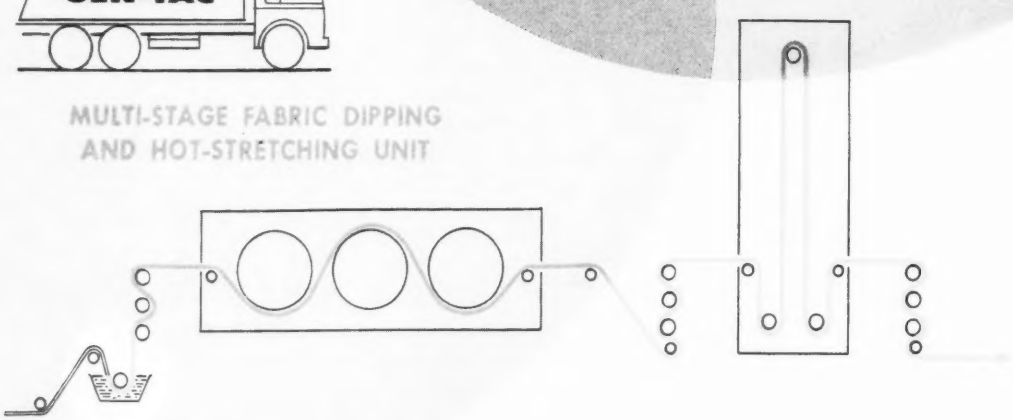

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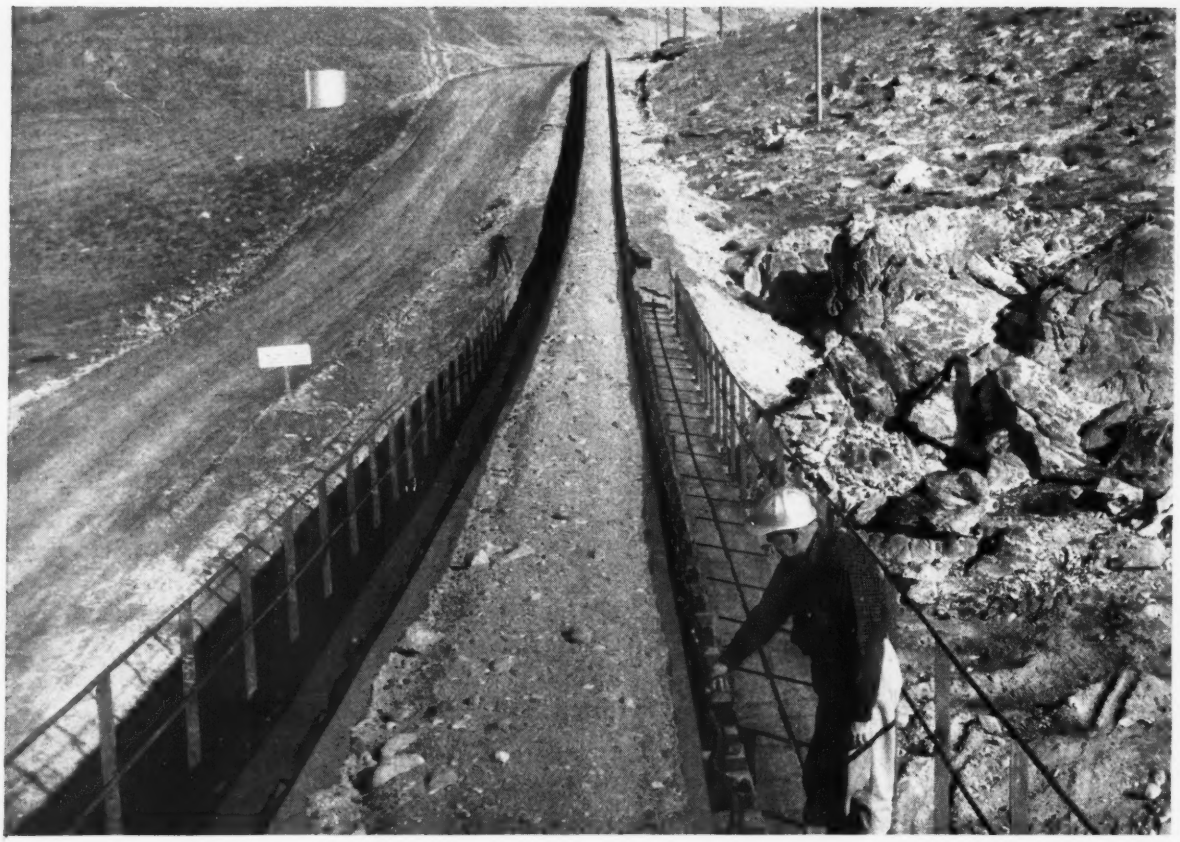
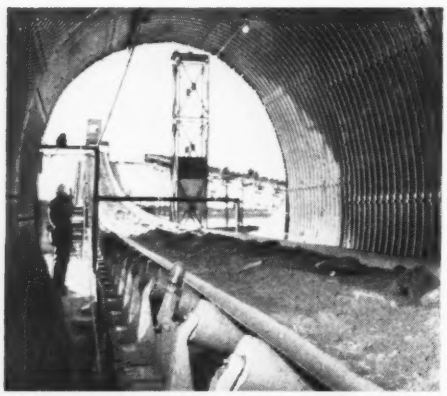


The "mainline" belt system consists of 2 individual conveyors, each approximately 4,000 ft. long pulley to pulley, laid out to meet the irregular terrain. Successive loads from a continuous line of 35-ton dump trucks are required to keep the system feeding at its peak capacity.



Shown here is one of two 72" conveyor belts that carry rock and earth to the lakeside after it has been deposited in a surge pile by the mainline conveyor. These feeders transfer gravel to two recovery conveyors which can fill a 3,200-ton barge in only 15 minutes!

AN EARTH-MOVING EVENT

This huge 54" conveyor system—nearly two miles long and traveling at speeds up to 850 feet per minute—is the longest downhill conveyor of its kind ever built. Capable of transporting 75,000 tons of material a day, it was manufactured by Hewitt-Robins for Morrison-Knudsen Company, Inc., and is being used to haul 30,000,000 tons of rock and earth required for the foundation of a 13-mile roadbed now under construction across the Great Salt Lake for the Southern Pacific Railroad. The system is equipped with special Hewitt-Robins patented drive mechanisms which not only act as an efficient braking system for the long down-grade, but generate enough electricity to serve 4,000 average homes. The belting itself is more than 23,000 feet long and required for its construction a special Mount Vernon fabric which was delivered to Hewitt-Robins in record time.

This is another example of how fabrics made by Mount Vernon Mills, Inc. and the industries they serve, are serving America. Mount Vernon engineers and its laboratory facilities are available to help you in the development of any new fabric or in the application of those already available.

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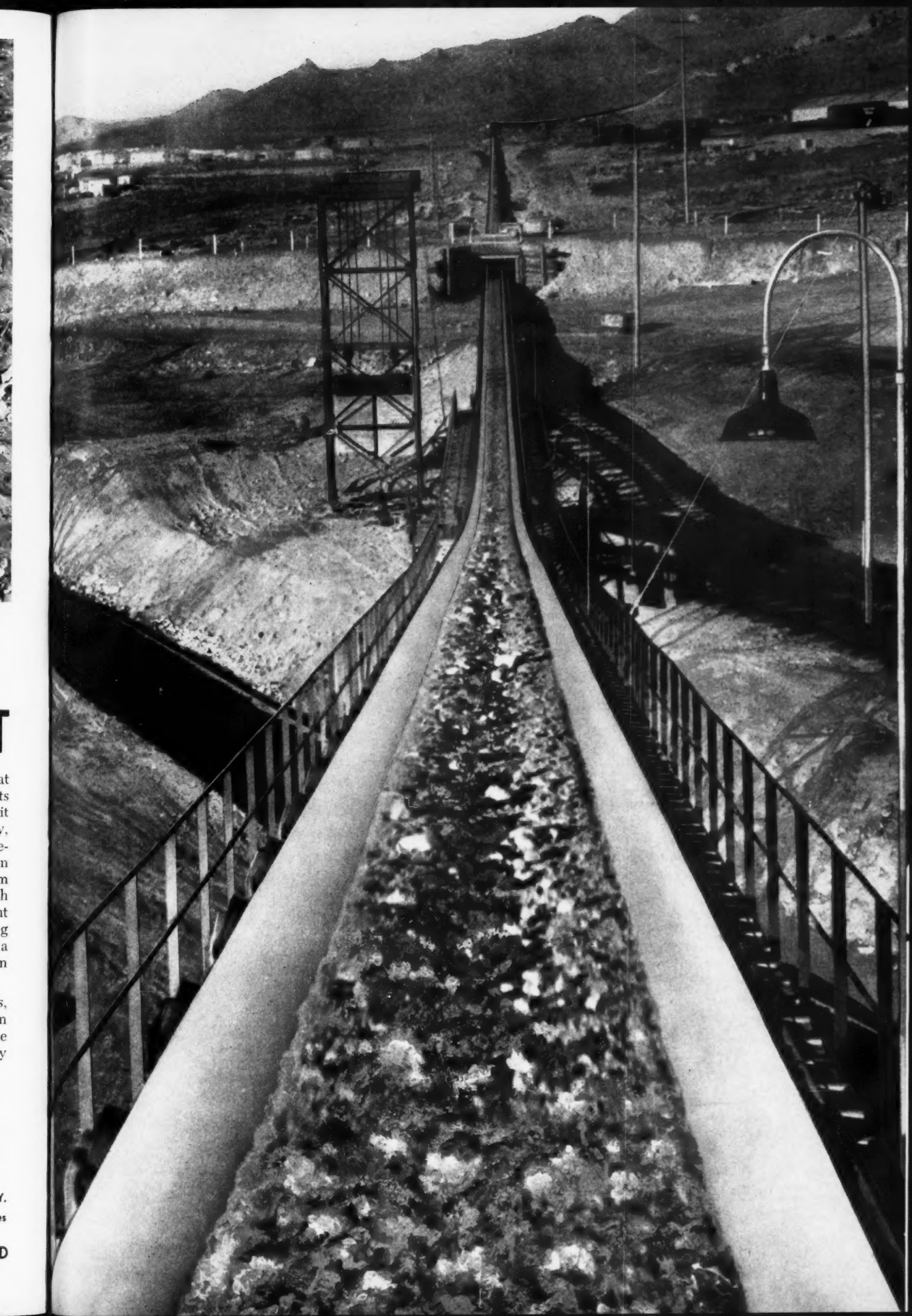

Have you seen the monthly

LOCKWOOD-HEILMAN RUBBER REPORT ...?

For many years Warren S. Lockwood edited and distributed "Lockwood's Monthly Rubber Report," which was widely read in the United States and 20 countries overseas. For many years, also, Howard H. Heilman has been one of the country's leading authorities on butadiene and an internationally known consultant on synthetic rubber generally.

Now the synthetic plants are in private hands and what takes place in the production, distribution and pricing of butadiene, styrene, GR-S and other synthetics affects the entire industry from the Indonesian smallholder to the largest consumer of rubber. Equally what happens in the production, distribution and pricing of natural rubber vitally affects the synthetic industry—from prospective Texas butadiene producers to developers of completely new synthetic polymers.

Lockwood and Heilman are in a unique position to comment usefully on this constantly changing picture. Lockwood reported on rubber from Singapore, Djakarta and London for the U. S. Government, served as Executive Vice-President of the Rubber Manufacturers' Association and for many years was president of the Natural Rubber Bureau. Heilman was in charge of butadiene production for the Office of Rubber Reserve and is recognized by both government and industry leaders as a top expert on synthetic rubber costing. For the past 10 years he has served firms in the chemical and petroleum field as a consultant on petro-chemicals and related products.

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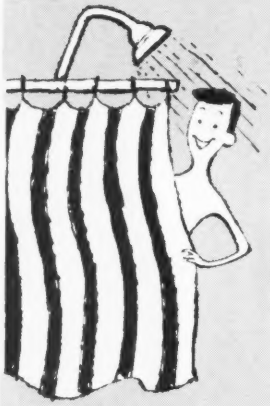

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How high load capacity is built into less space in Dodge-TIMKEN All-Steel pillow block

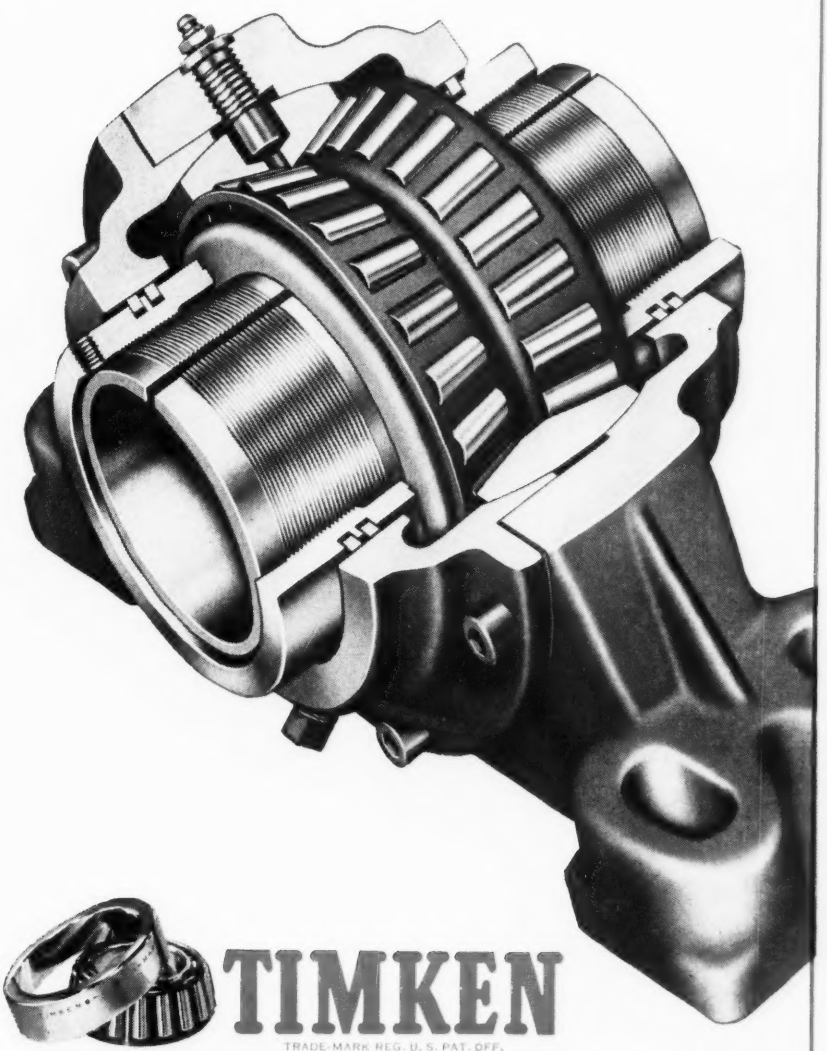
THIS rugged Dodge-Timken pillow block packs more capacity in less space than ever before. All-steel construction gives it extra strength and durability. The design is compact. No special thrust devices that take up extra space are needed—the two-row Timken® tapered roller bearing takes *both* radial and thrust loads in any combination. And full line contact between the rollers and races assures high load capacity.

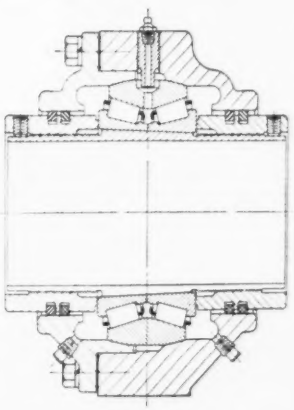
The cutaway view below shows the bearing. It is of special design, with tapered bore and self-aligning spherical outer surface—never requires adjustment. As in all Timken bearings, races and rollers are case-carburized and have tough, shock-resistant cores under hard, wear-resistant surfaces. Under normal conditions, the Timken bearing will last the life of the machinery with which the pillow block is used.

In addition to the all-steel pillow block shown here, Timken bearings are also used in the Type "E", Double-Interlock, Type "C", and Special-Duty pillow blocks—other versatile pillow blocks in the Dodge-Timken line with a wide variety of uses in industry.

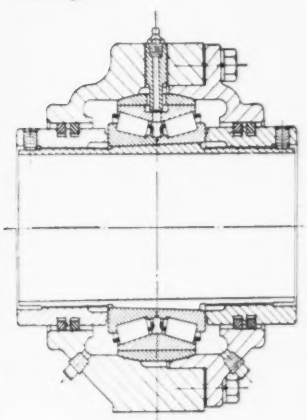
To be sure of the finest bearing steel, we make our own—America's only bearing manufacturer that does. No other bearing can give you all the advantages you get with Timken bearings. Include them in your design plans... specify them for the machines you buy or build. Look for the trademark "Timken"—it's on the bearing that makes any machine run better. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable: "TIMROSCO".

This symbol on a product means its bearings are the best.





How **DODGE MANUFACTURING CORPORATION,** Mishawaka, Ind., mounts Timken bearings in the Dodge-Timken All-Steel pillow block. Above: non-expansion block with fixed bearing. Below: expansion block with floating bearing.



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TAPERED ROLLER BEARINGS ROLL THE LOAD

EFFECTIVE

new HI-SIL® 233 price as practical on cost

BOTH ECONOMIES AND BETTER STOCKS RESULT FROM HI-SIL—HARD CLAY COMBINATIONS

A new and lower price of 8 cents per pound in carload lots, effective June 1, is announced for **Hi-Sil 233**. Increased rubber industry demand for this fine particle silica reinforcing pigment has resulted in production economies for Columbia-Southern, making this important price adjustment possible.

It has been noted previously that the advantages of higher quality and lower cost obtainable in **Hi-Sil 233** make it eminently practical to replace other pigments in rubber compounds with combinations of Hi-Sil and hard clay. This can now be demonstrated more strikingly than ever before, because of the new lower price basis. **Hi-Sil 233**–hard clay mixtures will give better quality stocks in natural, GR-S, butyl, neoprene, or nitrile rubbers than can be achieved with silicate pigments at the same cost . . . or will give stocks of equal quality at lower cost.

Compounders can now obtain these definite benefits by replacing any silicate type pigments presently used with mixtures of **Hi-Sil 233** and hard clay:

1. Greatly improved quality (demonstrated in test results below and on facing page) at the same pound-volume cost.
2. Equal quality at lower pound-volume cost.
3. Savings on warehousing, inventory and ordering of two pigments rather than three. Any combination of properties can now be yours through various loadings of **Hi-Sil 233**–clay.
4. Savings on rejection of finished goods. **Hi-Sil 233** mixes more readily and disperses better than the silicate pigments.
5. Savings on uncured scrap. Scrap from compounds based on Hi-Sil–clay mixtures can be reworked in subsequent batches without the undue softening or "mushiness" frequently noted where other pigments have been used.

Please read through the accompanying data for convincing test evidence of these statements.

Here is one of the many comparisons recently completed

(All are available to you as Hi-Sil Bulletin No. 14)

LTP Soling Recipe

A comparison was made between two soling stocks based on low temperature polymerized GR-S containing only a little natural rubber, and high styrene resin. One stock was loaded with a combination of **Hi-Sil 233** and hard clay, the other with a silicate pigment described by its producer as a "hydrated sodium silico aluminate." Both had the *same pound-volume cost.*

The Hi-Sil compound demonstrated higher tensile strength, tear resistance, and elongation; better resistance to abrasion and flexing. Hardness of the two compounds was about the same. The silico aluminate compound had slightly higher modulus.

The obvious superiority of the **Hi-Sil 233**–clay stock is apparent in the following tables.

Formulae

	S	T
GR-S 1502	90	90
#1 Ribbed smoked sheets	10	10
Marbon 8000	35	35
Zinc oxide	5	5
Silico aluminate	86.15	—
Hi-Sil 233	—	61.59
Hard Clay	—	24.53
MBTS	1	1
DOTG	2	2
Sulfur	3.5	3.5
Triethanol amine	0.5	2
100° C. m.p. coumarone resin	7.5	7.5

JUNE 1 . . .

makes quality loadings as on performance

Flex Resistance—Ross Flexer

Compound	Mins. Cure at 320°F.	Length of Break in .01" After Indicated Flexes									
		Original						Aged 24 hours at 212°F.			
		10,000	20,000	30,000	40,000	50,000	60,000	1,000	10,000	20,000	40,000
S	8	61	80	89	93	Comp.	—	55	89	Comp.	—
T	8	37	49	60	71	82	Comp.	24	50	76	96

Compound	Mins. Cure at 320°F.	Modulus 300% E.	Tensile	Elong.	Duro. A	Duro. C	Tear lbs/in.
S	4	1900	2180	370	96	70	350
	8	2050	2160	330	96	72	350
	12	2040	2110	320	96	73	350
	16	2120	2190	310	97	73	340
	20	2100	2120	310	97	73	350
T	4	1460	2710	550	93	69	340
	8	1850	2780	440	97	74	380
	12	1940	2840	420	96	74	370
	16	2010	2740	410	98	73	350
	20	2070	2570	380	99	73	350
Air Oven Aging—96 Hours at 212°F.							
S	8	—	2280	250	98	79	—
	12	—	2160	240	97	80	—
	16	—	2030	160	94	82	—
T	8	2660	2780	320	100	84	—
	12	2640	2770	330	100	84	—
	16	2550	2660	320	99	84	—

Abrasion Resistance—NBS Abrader

	Mins. Cure at 320°F.	Abrasion Index (% of Control B)
S	8	50.1
	12	36.9
T	8	55.6
	12	49.8

These comparisons, and others reported to the industry by Columbia-Southern over the past several years, strongly support our point that compounders can economically realize a virtually unlimited range of properties in non-black stocks through proper Hi-Sil–clay loading. **Hi-Sil 233** imparts high modulus and tensile strength, superior tear and abrasion resistance to colored and transparent stocks designed for many different consumer and industrial applications.

Hi-Sil Bulletin No. 14, reporting in detail eight new comparisons, is now available. To assure prompt receipt of this important paper, please mail a request to our Pittsburgh office, addressing Room 1929-W.

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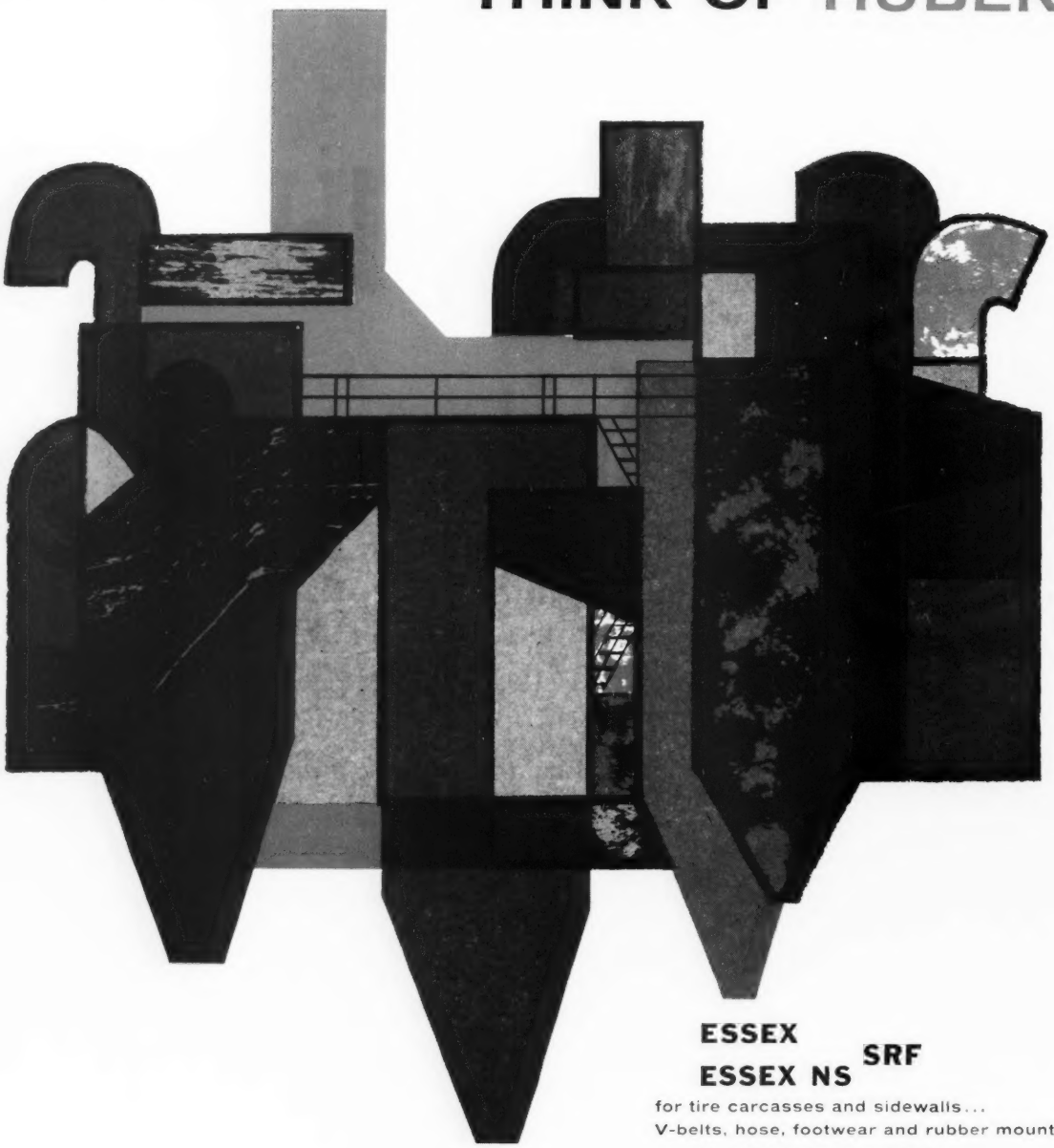

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RUBBER WORLD

EDITORIAL

MAY, 1957

False Economy by Congress Threatens End of BDSA

MUCH has been said recently about the need of reduction of the proposed federal budget for fiscal 1958 of $71.9 billion, and rightfully so. *An action by the House Appropriations Committee in April, however, in eliminating fiscal 1958 funds for the Commerce Department's Business and Defense Services Administration could hardly be called anything but false economy.* The amount involved, $3.5 million for the 25 BDSA industry divisions, and $75,000 for the Rubber Branch, is entirely out of proportion to the damage that could result to the government itself and to the business community, if the services provided by BDSA were eliminated.

BDSA and its 25 industry divisions, including the Chemical and Rubber Division, are an essential part of our complicated and far-reaching preparedness program. Among the duties of the Chemical and Rubber Division are reports to the Office of Defense Mobilization on our ability to produce needed military and civilian rubber products in time of war, and on the reliance that can be placed on raw material inventories. The Division collects and distributes statistics on production, consumption and stocks of natural and synthetic rubbers and latices, and analyzes and forecasts future trends and needs in this connection.

These records, analyses, and forecasts are relied upon by other government agencies for use in policy guidance and are used also by the rubber industry and its supplier companies in planning many of their business activities. *Certainly the amount of taxes paid by these companies entitles them to a continuation and even expansion of this service.*

Instead of doing away with the BDSA, it should be retained if the preparedness program and the business community are to operate at maximum efficiency for the nation as a whole. To do otherwise would certainly justify applying the phrase "penny wise and pound foolish" to the Congressional appropriations committees in this instance. Today's industry as well as government needs more and better statistics instead of less.

The unsatisfactory situation with regard to present government statistics on rubber has been the subject of editorial comment in this column in December, 1956, and February, 1957. It is understood that some improvement in the classification of the products of the various branches of the rubber industry was being considered, with the help of the BDSA Chemical and Rubber Division. If the Division is allowed to go out of existence, this progress will be slowed considerably.

It is quite probable that if the Senate Appropriations Committee does not restore funds for the BDSA and reach agreement with its companion House committee for the restoration of these funds, the work of the BDSA will still be carried on by some other government agency. Industry at present is able to share in much of the information collected by BDSA, but if collected by certain other agencies, this information might no longer be so easily available.

Industry leaders are urged to do everything possible to explain to these Congressional appropriations committees the false economy of eliminating the BDSA and its work. A special unit on rubber has been a part of Commerce Department activities since 1921.

R. G. Seaman

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TELLURAC	—	1
ALTAX	0–1.5	1
Sulfur	2–1	2

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Gamma Radiation and the Rubber Industry[1]

By S. D. GEHMAN

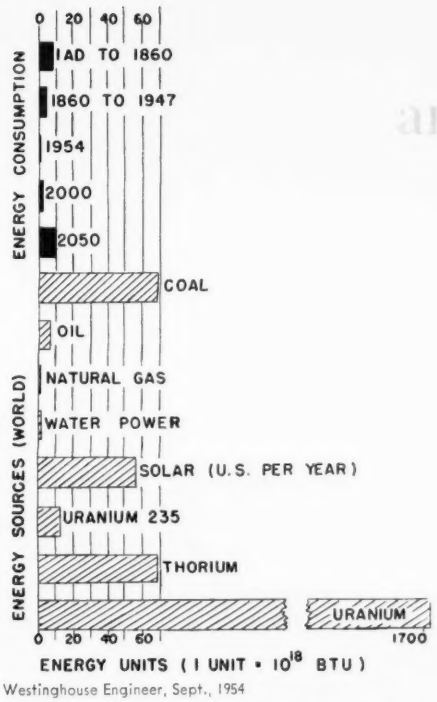
Goodyear Tire & Rubber Co., Akron, O.

Energy needs of our industrial civilization for the next 50 years are expected to be satisfied in part by power from atomic energy. Radiation is a by-product of atomic energy, and its availability and cost are of direct interest to the rubber as well as other industries.

Co60 radiation sources have been installed at universities, research institutes, and industrial laboratories, including the research laboratory of the Goodyear Tire & Rubber Co.

Rubber chemistry is essentially a free radical type of chemistry so that gamma radiation induced reactions are of particular interest. Polymerization by radiation can produce results not possible by chemical means. Vulcanization by radiation may permit the development of new types of rubber which cannot be readily vulcanized by chemical means.

A special multi-purpose atomic reactor might be developed for the rubber industry which could provide nuclear heat for electric power and process steam generation, radiation for vulcanization and for catalyzing chemical reactions, and radioisotopes for process control and an additional source of income.



Westinghouse Engineer, Sept., 1954

Fig. 1. Estimates of energy consumption and sources throughout the year

THE practical interest in applications of intense nuclear radiation spring from the long-range expectations for atomic energy. Radiation is a by-product of atomic energy so that the availability and costs of radiation sources will be tied to atomic energy developments. These, in turn, will get their impetus from the continually rising energy requirements of industrial civilization.

World Energy Requirements

It appears that these energy needs in the course of 50 years or so may be prodigious as judged by our present energy usage and known sources. In the past century the annual world consumption of energy increased by about a factor of ten. The annual multiplication factor for energy consumption tends to become larger and larger as the world population inexorably rises. Each individual contributes to the drive for the higher standards of living and comfort, increased leisure, and other benefits which can come from having machines do more of his work. These mounting pressures have caused considerable study as to the adequacy of energy sources in relation to potential demands.

Figure 1 gives a simplified representation of some estimates of energy requirements and available sources. Past and future energy consumption is indicated by the solid bars. At present rates of consumption and growth the energy use in the next 50 years could be as much as that used in the 1956 years just past. In 25 years we may be using five times as much energy as today.

From such studies, the uranium reserve assumes in-

[1] Presented before the Philadelphia Rubber Group, Philadelphia, Pa., Jan. 25, 1957.

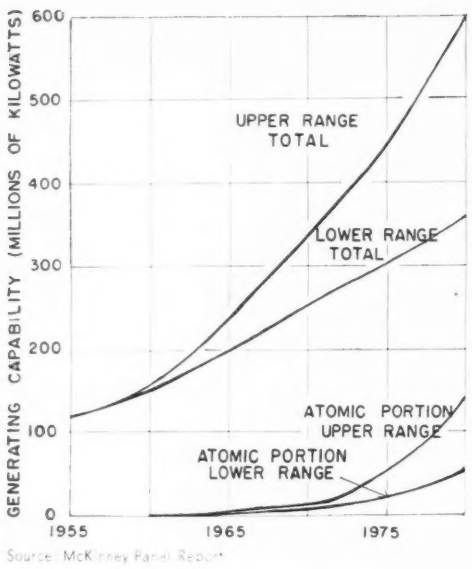


Fig. 2. Forecast of total power demand in the United States, 1955-1975, and portion to be obtained for atomic sources

creasing significance as a possible source for future energy requirements and cheap and abundant by-product radiation. It may turn out that we are starting a broad transition period to a new source of energy. This sort of thing has happened before. In 1850, wood furnished 89% of the energy used in the United States. Presumably the switch toward atomic energy will be very gradual and almost imperceptible for a number of years. Time is required not only for research and development, but for the accumulation of engineering and operating data. It is expected that atomic power generation will grow with the expansion of the total economy so that there will be no revolutionary impact. There will be an increasing tendency for new power plants to be atomic while the old plants continue in use.

The results of the complex estimates of engineering possibilities, costs, and requirements for the United States assembled by the McKinney panel are represented by the curves in Figure 2. The upper and lower forecasts illustrate the reasonable uncertainty. Not until 1965 is it expected that enough experience will be gained for rapid expansion of atomic power generating facilities. Although the relative amount of atomic power generation may appear small, even for 1980, it should be noticed that the actual value may be of the order of our present total power generation, over 100 million kilowatts.

The basic needs of power in various parts of the world will no doubt cause a wide variation in this growth pattern. Great Britain is moving ahead much more rapidly and expects to have 5-6 million kilowatt of atomic electric power by 1965. By that time one-fourth of her total requirements for new generating capacity will be atomic. The circumstances driving Great Britain so rapidly to atomic power afford, perhaps, a preview of how it may eventually happen most everywhere.

Atomic Power Radiation Problems

As these atomic energy programs develop, there will be a stupendous, unprecedented production of radioactive material. The conventional unit of radioactivity, the curie, corresponding to the activity of one gram of radium, is scarcely adequate to give any conception of the radioactivity involved. The world supply of radium is only about five pounds, or 2,500 curies.

The worldwide 50-year accumulation of fission products with such a power program as has been discussed has been estimated to be of the order of 10^{11} curies. One of the principal elements would be the very fine gamma emitter, Cs (cesium) 137, which has a half life of 33 years. What to do with such radioactivity in order to avoid contamination of land, sea, and air has been food for considerable thought and is known as the disposal problem. Concentration and burial in desert or abandoned areas, projecting into interstellar space, disposal at sea, fusion with clays to form insoluble products and then burial, are suggestions which, at best, can be carried out only with a great deal of exacting detail and expense and with results which may not be entirely satisfactory.

The quantities of radiation involved are sufficient to be regarded as a new type of very special power. The values can be more conveniently expressed as kilowatts (1000 watts) or megawatts (one megawatt is one million watts) of radiation rather than curies. When the radiation is absorbed in matter, heat is generated, and the conversion factor between calories and watts gives the power of the radiation. About 1% or 2% of the power from an atomic reactor may appear as gamma radiation. By 1965, gamma power from reactors should reach a figure of one or two megawatts and by 1975 it may be 10 megawatts.

Three general methods have been proposed for using this intense radiation. The radiation might, by special arrangements, be made available directly as it is produced at the reactor. Or spent fuel elements could be removed from the reactors and used as sources of radiation. Or the radioactive fission products could be separated from the spent fuel elements by a purification process, concentrated, and used as a source. Activation of elements such as cobalt in reactors may also eventually become economical for large sources.

If useful applications can be found for the unique properties of radiation energy, these fission by-products of atomic power can be converted into an asset, and the cost of atomic power appreciably reduced. There would be an economic advantage in using spent fuel elements as radiation sources and thus eliminate the cost of separating the fission products. This will be especially attractive if the "burn up" is sufficient to make recovery of the unused fuel in the elements uneconomic. But there are a number of complications and problems in the use of spent fuel elements as radiation

[24]"Peaceful Uses of Atomic Energy, Report of the Panel on the Impact of the Peaceful Uses of Atomic Energy," U. S. Government Printing Office, Washington, D. C. (1956).

S. D. Gehman

The Author

S. D. Gehman, head of the physics section, research and development division, Goodyear Tire & Rubber Co., received his A.B., M.A. and Ph.D. degrees from the University of Pennsylvania.

Dr. Gehman joined Goodyear in 1929 and has been associated with the research division continuously since that time.

He is a member of the American Chemical Society and its Rubber Division and of the American Physical Society and is, moreover, the author of many technical and scientific publications on the physics and testing of rubber. He also has been a member of the Editorial Advisory Board of RUBBER WORLD for a number of years and was recently made an associate editor of *Rubber Chemistry and Technology*, publication of the Division of Rubber Chemistry, ACS.

Recently, Dr. Gehman has been active in various radiation research programs and currently heads up Goodyear's activity in this field.

sources. Besides the problems in transportation, the rapid decay in intensity puts a time limit on their use.

Cs137, on the other hand, has a long half life of 33 years and can be an excellent gamma ray source for most purposes. Plans and facilities for recovering Cs are, at the moment, however, rather uncertain.

Co60 As Radiation Source

At the present time practically all of the sources used for experimental work with gamma radiation are Co (cobalt) 60, which is practically the only isotope now available for a high-intensity source. Co60 is made by activation of ordinary cobalt in a reactor by absorption of neutrons. The period of activation may be a year or more, depending on the specific activity desired and the neutron flux in the reactor. Co60 has a half life of five years and emits gamma rays of 1.17 and 1.33 mev[3] energy.

There is some possibility that Co60 will be produced in reactors as a means of revenue. One or 2% neutron absorption in the reactors by Co, which might very well be in conjunction with reactor control rods, could produce megawatts of Co60 gamma radiation if atomic power develops in the way which has been outlined. One thousand curies of Co60 has a radiation power of about 14 watts. So the usual experimental sources which generally are in the range from 1,000 to 5,000 curies are still quite low powered as compared to the megacurie sources envisioned for the future.

Results which have been obtained with intense radiation and the long-range outlook in regard to the availability of abundant radiation, as well as scientific curiosity, have led to the installation of numerous Co60 sources at universities, research institutes, and industrial laboratories. These source installations take a variety of forms, depending on the type of research which it is desired to carry out, the strength of the source, and the budget available.

The simplest and most economical arrangement is to enclose the source in a lead shield. Another arrangement which is rather common and permits more flexibility in the use of the source is to have it at the bottom of a well or tank. Here water provides the shielding, and all the irradiations are carried out under water.

The Goodyear Tire & Rubber Co. has constructed a new, fully equipped radiation research facility which has an unusually favorable arrangement with the source. It has the convenience of water shielding, permits irradiations in air, and yet avoids the limitations and expense of remote manipulations. It is conveniently adjacent to the main research building of the company at Akron, O.

There is a heavily shielded area, usually referred to as a "cave," for housing the radioactive source. Next to it is a well-equipped physics and chemistry laboratory for the preparation of materials and test specimens and the evaluation of the results and products of irradiation experiments.

Access to the cave from the preparation laboratory is by means of a labyrinth with four-foot wide aisles. This eliminates the need of any massive, cumbersome shielding door. The walls of the cave are made of reinforced concrete, four feet thick. The roof is three feet thick. The shielding is adequate for a 10,000 curie source of Co60 or for about a million curies of the fission by-product Cs137. There is a three- by six-foot pool or well in the cave which is 17 feet deep. It is lined with a ¼-inch thick welded aluminum shell. All the fittings of the pool are either aluminum or stainless steel. The well is large enough and deep enough to permit underwater transfer of the radioactive source to or from a shipping container. This well is also large enough to accommodate spent reactor fuel elements which are becoming available as intense sources of gamma radiation.

Ventilation and heating of the cave are accomplished through an underground duct. A duct is also provided for the entrance of special lines required for experiments such as thermocouples, steam, cooling or heating water, etc.

[3] This is the energy of the individual entity in the radiation. One mev is the energy acquired by an electron when accelerated by one million volts.

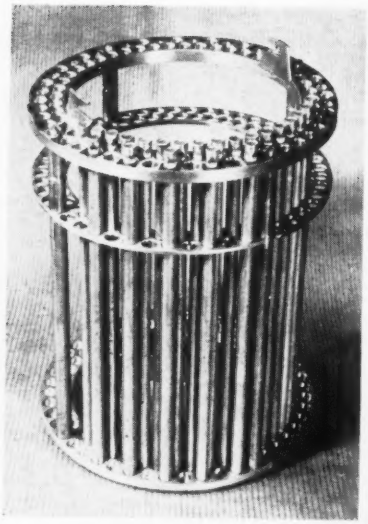


Fig. 3. Goodyear radiation research facility source consists of small cylinders of Co60 contained in 72 aluminum pencils arranged in cylindrical array as shown

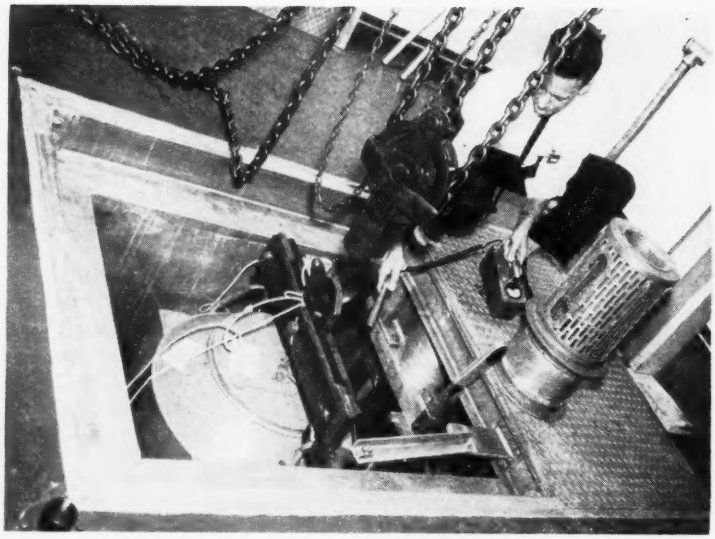


Fig. 4. Container for radiation source being lowered into well

The source is 2100 curies of Co60 which was activated in the NRX reactor at Chalk River, Canada. The source was assembled at Chalk River and shipped by truck in a specially designed load container weighing 8,000 pounds.

The Co60 is in the form of small cylinders, one inch long and ⅛-inch in diameter. Each cylinder is sheathed in 1/16-inch thick aluminum. Nine of these slugs are assembled in an aluminum pencil about 10 inches long. The source consists of 72 of these pencils arranged in the cylindrical array shown on Figure 3.

Figure 4 shows the container for this radiation source in the top of the well being lowered away.

Figure 5 is a photograph of the source in place on the elevator in the well. This picture was taken with the underwater lights. The most intense radiation occurs in the central volume which is 6⅞ inches in diameter.

The method of using the source represents a departure from the usual procedures of either using a source in air in the limited confines of a lead container or with remote manipulation or conducting all of the irradiation experiments under water. The type of installation with remote manipulation is very expensive, and underwater operation is inconvenient.

In the present installation the source is stored at the bottom of the well when not in use. Equipment and experiments can be set up without remote manipulation since the radiation level in the cave with the source at the bottom of the well is far below tolerance. Then the operator leaves the cave, and the source is brought above the water for the irradiations. To permit raising the source, it is mounted on an elevator which can be raised or lowered by means of a stainless-steel cable and windlass mounted on the outside of the cave wall. The cable passes through a duct in the floor of the cave. When the source is raised, it is brought up inside the sheet aluminum housing shown on the well cover in Figure 6.

This illustration shows the Cerenkov glow[4] produced by the source in the water. Samples to be irradiated may be placed in the central container or around the outside of the housing. Figure 7 shows the interior of the cave with various samples in position for irradiation. The possibility of setting up chemical equipment in the radiation field is noteworthy. The large volume of material which can be irradiated at one time is a distinctive feature of the arrangement.

The window through which the source may be viewed is visible at the left in Figure 7. This consists of 36-inch thick radiation-resistant glass.

The safety precautions are set up to insure that no one be in the cave or enter the cave when the source is up. There is a mechanical interlock between the cave door and the windlass which prevents the cave door from being opened unless the source is in the completely down position. Before anyone enters the cave, he locks the source in the down position at the windlass and takes the only key with him so that the source cannot be raised while he is in the cave. Anyone entering the cave carries a monitor and wears a film badge. In the very unlikely case that the elevator would become jammed in the up position so that it is not possible to pull the source back down into the well, there is an emergency trip mechanism by which the source can be dropped through the elevator platform. This mechanism is actuated by a cable which passes through the duct into the laboratory. The radiation level in the work area of the laboratory when the source is up is about one-tenth of the tolerance level of 7.5 milli rep/hr. specified for a 40-hour week.

[4] Visible light produced when charged particles traverse a transparent medium with a velocity exceeding the velocity of light in the medium. Here the charged particles are electrons ejected from the water molecules by the gamma radiation.

Fig. 5. Radiation source in place on elevator in well

Fig. 6. Cerenkov glow produced by source in water. Radiation source, when raised, is brought up inside housing shown on well cover

Fig. 7. Interior of cave with various samples placed in position for irradiation by author

The purpose of this installation is to permit the exploration of potential applications of high-intensity radiation for all the diversified interests of the Goodyear Tire & Rubber Co. A great deal of research effort and experience with handling intense radiation sources will be necessary before any of the potential applications materialize. The design of the installation is eminently suited both for the research investigations and for securing experience with massive radioactivity.

Radiation Effects on Polymers

The effects of high-intensity gamma radiation of most interest for the rubber industry stem from the way in which the energy is dissipated in organic compounds to result in chemical reactions. The photon or particle-like entity which carries the electromagnetic energy of the gamma radiation can interact with the electronic systems of atoms and molecules to disrupt them, producing ionization or excitation and free radicals. The gamma ray energies with which we are concerned are too low to affect the nucleus; hence no radioactivity is induced.

In a sense, these photon projectiles generate an extremely high temperature in a very small localized volume comparable to molecular dimensions. The photon loses energy with successive interactions, generating secondary gamma rays of lower energy and knocking out electrons until its energy is dissipated. As a matter of fact, most of the effects are produced by these secondary rays. The number of interactions of the primary photons is relatively small.

In organic compounds, the chemical effects result from the ionization and electronic excitation, usually through the production of free radicals. In other words, radiation is an alternative agency to heat for energizing molecules for chemical reactions. Since it is an expensive form of energy, its use is most promising for chain-type, free radical reactions where it acts like a trigger to start or control the reaction. Rubber chemistry is essentially a free-radical type of chemistry so that these gamma radiation induced reactions are particularly interesting for us.

There are a number of unique features for gamma ray induced reactions. Consider polymerizations for instance. Although it has not been possible to polymerize by radiation monomers which cannot be polymerized

chemically, practically all addition polymerizations which proceed by free-radical mechanisms appear to be catalyzed by radiation. The new possibilities include such things as lower temperatures and pressures, polymerization in the solid state, absence of any catalytic impurities in the product, and external regulation of the free-radical production at any stage of the polymerization.

Thus there is opened up a wide new field for polymerization research in which radiation can do things which cannot be accomplished by usual chemical means. The radiation can produce active centers or reaction points for grafting a monomer unit on to a polymer even if the polymer contains no double-bonds. New types of graft polymers may be created in this way which could conceivably include some very interesting new types of synthetic rubber.

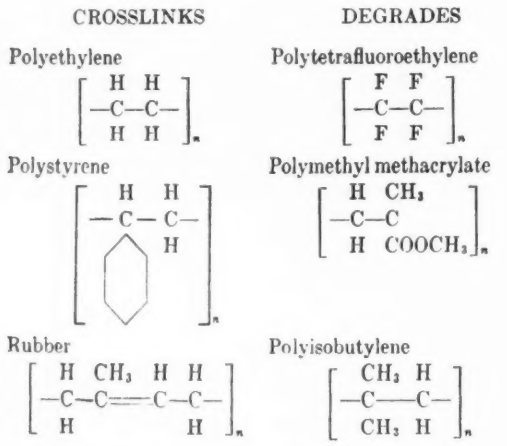


Fig. 8. How radiation affects polymers

Radiation effects on solid polymers are complex and, depending upon the polymer and circumstances, may include cross-linking, degradation, evolution of hydrogen or other gaseous fragments, and the production of unsaturation and oxidation. The predominance of cross-linking or degradation depends upon the monomer structure. Several examples are given (Figure 8) of the action of radiation on polymers in respect to cross-linking. When a carbon atom in the chain has two hydrogen atoms substituted, degradation is the rule.[5]

In some cases, radiation cross-linking improves the physical properties. This has become especially well known for polyethylene for which, in addition to better strength properties, a higher softening point can be secured.

Cross-linking effects of radiation on elastomers may have many interesting long-range ramifications for the rubber industry. In this connection we think naturally of vulcanization. An experimental survey which we carried out showed that many types of rubber can be vulcanized by gamma radiation. Test pieces of uncured rubber sheets were exposed to a 3000 curie Co60 source at the University of Michigan. The radiation dose required for vulcanization was relatively large, 1 to 5 x 10^7 rep.[6] Figure 9 shows how such a dose compares with those required for some other suggested applications of radiation.

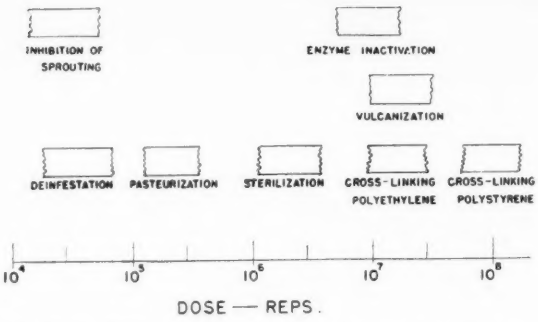


Fig. 9. Radiation dosages required to produce various effects as compared with those for vulcanization and cross-linking of polymers

If there were no heat losses, the vulcanizing dose of radiation could actually raise the temperature of the rubber to ordinary vulcanizing temperatures. The usual vulcanizing accelerators and sulfur had but slight influence on gamma ray vulcanization. Fillers seemed to enhance the effects of the radiation, probably due to scattering effects.

Figure 10 shows the development by irradiation of the physical properties of a black masterbatch.[7]

Figure 11 compares the modulus and tensile strength relation for radiation cures.[7]

Possibly ways can be found to reduce the radiation dose required for vulcanization. Or it may be possible to develop special types of synthetic rubber which are especially susceptible to radiation cross-linking. Interesting features of gamma ray vulcanization include the possibility of developing new types of rubber which cannot be readily vulcanized by chemical systems. This chemical stability, in turn, could be reflected in su-

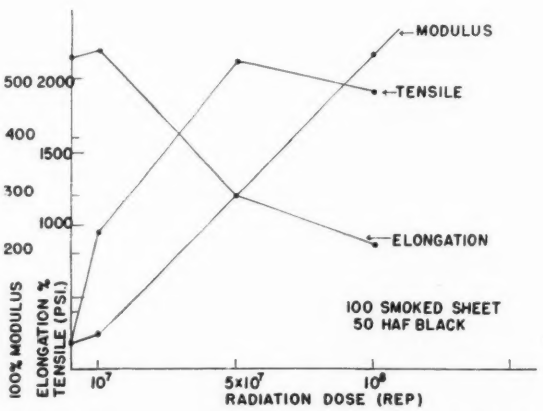


Fig. 10. Gamma ray vulcanization of black masterbatch

[5] A. Charlesby, *Nucleonics*, 12, 6, 18 (1954).
[6] One rep is that quantity of ionizing radiation which, upon absorption in body tissue, is accompanied by the gain of 93 ergs of energy per gram of tissue. Rep is an abbreviation of roentgen equivalent physical.
[7] *International J. of Applied Radiation & Isotopes*, 1, 102 (1956).

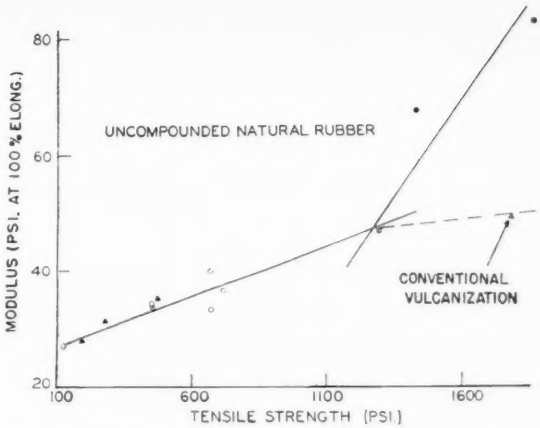


Fig. 11. Relation of modulus and tensile strength for gamma ray vulcanized uncompounded natural rubber

perior aging and resistance to high temperature. Gamma ray vulcanizates of present rubbers have excellent aging properties due to the absence of sulfur and chemicals and perhaps due to the fact that the cross-links are direct carbon-to-carbon bonds rather than polysulfide linkages.

Gamma ray vulcanization should permit the vulcanization of shapes or preforms without the distortion which would occur with heating. Processing of the rubber stock could be carried out faster at higher temperatures if no vulcanizing ingredients were present. With such unique features it is not too much to hope that with long, hard research work and suitable developments in atomic energy and cheap sources of radiation some of the potentialities of radiation vulcanization may find a place in industry.

Summary and Conclusions

In concluding, consideration should be given to another aspect of the relation of the rubber industry to the developing atomic energy program. The rubber industry uses large amounts of process heat, so-called low-grade steam. It is just this type of steam that atomic reactors can produce naturally, that is, most economically and with a minimum of materials and engineering problems. The size of the power plant for a "10,000 tires a day" plant might be of the order of 50-60 megawatts. This is smaller by a factor of about ten than the size of reactors generally considered to have economic feasibility for electric power generation. On the other hand, it is commensurate with some of the reactors in the Atomic Energy Commission's power reactor experiments.

Much valuable experience should, therefore, be acquired in the next few years on reactor constructions in sizes which would be applicable for tire plants. Even though it is not anticipated that such reactors would be economical for electric power generation alone, a combination of low atomic energy fuel cost with a lower construction cost for such a low-pressure reactor might make it economical as the power supply for a tire plant. Radiation will be a by-product of such a reactor just as for any other reactor.

If radiation turns out to be a useful processing agent, for vulcanization, for instance, the reactor might be specially designed to make the most of the radiation. There are several schemes for doing this. One of the most promising is to use the gaseous fission products from a homogeneous type of reactor. The gaseous fission fragments of xenon and krypton are intense gamma emitters. Presumably 1% or 2% of the total reactor power can be realized as gamma radiation if the gases can be used a few seconds after fission.

Alternatively, a reactor with solid fuel elements might possibly be designed in such a way as to facilitate the use of the spent elements as gamma ray sources.

From this sort of thinking, we arrive at a dream for a multi-purpose reactor with functions such as those illustrated in Figure 12. The reactor should produce the electricity and process steam for the plant, provide intense gamma radiation, and possibly isotopes for revenue.

So the rubber industry can look forward in several directions for eventually sharing in the benefits and stimulation which generally accrue from the impact of new technologies such as are developing from the atomic energy program.

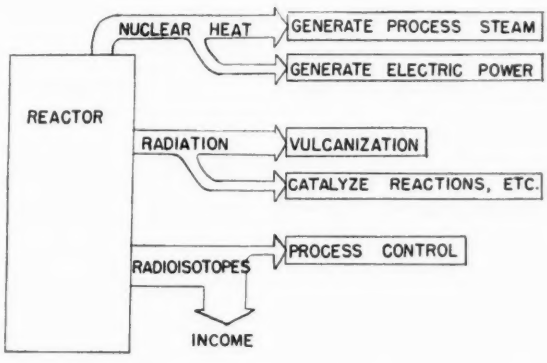


Fig. 12. Schematic diagram of functions of possible future multi-purpose atomic reactor

Engineering Students Increasing

More students are preparing for engineering careers this year than at any time since 1948, according to the American Society for Engineering Education, which, together with the United States Office of Education, compiled figures showing that a total of nearly 243,000 men and women were studying in accredited engineering colleges last fall.

This total is almost equal to the all-time high of 1947, when the colleges were jammed with World War II veterans. Engineering students this year amount to 12.5% of the total of men attending colleges, compared with 12.1% a year ago.

Development of Magnesia-Loaded Nitrile Rubber Composition for High-Temperature Oil Resistance

By R. A. CLARK and W. H. GILLEN
Battelle Memorial Institute, Columbus, O.

A magnesia-loaded compound was developed that withstood the severe aging conditions for 168 hours, but within the scope of the investigation and including an attempt to reduce the amount of unsaturation in the nitrile rubber, improvement of the aging of the magnesia-filled stock beyond 168 hours was not possible.

An effort was made to develop a nitrile rubber compound to meet certain minimum physical properties after 500 hours' immersion in a synthetic diester lubricant at 350° F.

Carbon black and non-black fillers, curing systems, antioxidants, plasticizers, polymer acrylonitrile content, and other factors were investigated.

MAGNESIA has been found to be an excellent filler material for making nitrile rubber more resistant to hot-oil aging. This fact was discovered in connection with an extensive compounding program to develop compositions resistant to diester-type lubricants, such as Esso Turbo Oil-15,[1] at 350° F.[2] One phase of this study, which was reported earlier,[3] relates to the use of acrylate-type rubber for this same application. This latter rubber, when properly compounded, produced stocks that remained flexible and usable when immersed in Turbo Oil-15 at 350° F. for 500 hours, although these stocks swelled more than 35%.

Parallel investigations of other classes of rubber revealed that the nitrile type could easily be compounded to swell only 25% or less. These compositions were prone to harden after 72 hours of hot-oil aging, however, and exhibited surface cracking when flexed 180 degrees after removal from the oil.

The present paper describes efforts to develop a nitrile-rubber composition having the following target properties before and after 500 hours' immersion in Turbo Oil-15 at 350° F:

Property	Unaged	Aged
Tensile strength, psi.	1000 (min.)	500 (min.)
Elongation, %	200 (min.)	100 (min.)
Hardness, Shore A	50-80	50-90
Swell, %	—	30 (max.)
Cracking	—	Pass 180-degree flat bend

Procedures Followed

The nitrile rubber compounds were milled, cured, and tested for stress-strain properties according to ASTM[4] Methods D 15-52T and D 412-51T. Dumbbell test specimens were cut with ASTM die C.

The hot-oil aging of rubber specimens was conducted in an aluminum-block type heater, drilled to contain sixty 38- by 200-millimeter test tubes.[5] The temperature of the block was maintained at 350° ± 2° F. The individual specimens were suspended in the test tubes on a stainless-steel wire which hung from the lip of the test tube. The test tube was covered with the top of a Petri dish (size 30 by 50 millimeters). Between the test tube and the cover the wire caused a gap which allowed free access of air into the tube during aging. Each test tube contained 140 milliliters of Turbo Oil-15.

When the various aging periods were completed, the tubes were removed from the heater and allowed to cool for one hour. The rubber specimens then were removed from the oil, dipped quickly into acetone to remove oil from the surface, and blotted dry before being tested.

The 180-degree bend test involves folding a rubber sample on itself by hand. It is an arbitrary test used by the Materials Laboratory, Wright Air Development Center, to reveal surface hardening and flex-crack resistance of rubber after hot-oil aging.

Carbon Black Stocks Aged Poorly

A series of stocks was made with a high nitrile rubber[6] that contained various loadings of HAF black and plasticizer. Data in Table 1 show that excellent original

[1] Esso Standard Oil Co.
[2] Wright Air Development Center, Dayton, O. Report TR 54-190; Parts 1, Apr., 1954; 2, Dec., 1954; and 3, Aug., 1955.
[3] W. J. Mueller, R. A. Clark, *Ind. Eng. Chem.*, June, 1956, p. 982.
[4] American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.
[5] E. J. Bradbury, R. A. Clark, RUBBER WORLD, Sept., 1956, p. 872.
[6] Hycar 1001, B. F. Goodrich Chemical Co.

The Authors

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Burt & Charlton, Inc.

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Dr. Clark was employed by The Goodyear Tire & Rubber Co. between 1935 and 1937, was a graduate assistant at Ohio State in 1938 and 1939, and was employed by American Zinc Sales Co. from 1939 until 1942. From 1942 until 1946 he was an officer in the Chemical Corps, U. S. Army.

He joined Battelle Institute in 1946 as a research engineer and has held his present post since 1949.

Dr. Clark is a member of the American Chemical Society and its Division of Rubber Chemistry and of the Society of Plastics Engineers. He is a Lieutenant Colonel in the U. S. Army Reserve, Research and Development Unit.

William H. Gillen, principal chemist, rubber and plastics division, at Battelle, received a B.S. in chemistry from the University of Cincinnati in 1948 and a B.S. in education from Ohio State University in 1949.

Mr. Gillen has been at Battelle since 1950, where his work has been in the field of high-temperature, oil-resistant rubber compounds for use in the automotive and aircraft industries.

He is a member of the American Chemical Society and its Rubber Division.

William H. Gillen

properties can be obtained with compositions of this type. An appreciable loss in properties occurs during aging at 350° F., however, with tensile strength declining to approximately 1000-1300 psi. after 72 hours' exposure to Turbo Oil-15. A further drop in tensile strength to about 700-1000 psi. occurs after 156 hours.

Despite these losses the stress-strain properties remained above the minimum target requirements, but the rubber was unsatisfactory because of poor crack resistance, which was not improved in the slightest by employing phenyl-beta-naphthylamine as an antioxidant. Plasticization was of no benefit either, in this regard, possibly owing to rapid extraction of the plasticizer by the aging oil.

It was then considered possible that reducing the carbon black content in stocks of this type might enhance crack resistance by contributing toward greater elongation and swell, both of which should help in the bend test. The lower amounts of carbon black shifted properties in this direction, but did not reduce cracking, as noted in Table 2. Samples aged in air hardened much more rapidly than those aged in oil, probably owing both to the greater availability of oxygen and to the lack of plasticization by the aging oil. The test tubes for oil-aging, it should be noted, were not sealed. Hence, even the oil-aged samples, though immersed in oil, had access to air.

Magnesia Improved Aging Characteristics

Since results obtained with carbon black were not encouraging, consideration was given to the possible use of non-black fillers. Although fillers of this type usually are less reinforcing than carbon black, it appeared that physical properties should move in this direction to overcome cracking. This point was suggested by the better properties (higher elongations) obtained with the less reinforcing types of carbon black (MT and FT).

One of the first materials considered as a filler for nitrile rubber to achieve superior heat resistance was zinc oxide, since this material has been used in loading levels up to 100 phr (parts per hundred rubber) to produce stocks having good air-aging characteristics.[7]

Magnesia, because of its similar chemical nature, was included as a parallel material for comparison. The results shown in Table 3 demonstrate that magnesia-loaded stocks evidence less cracking and far better retention of stress-strain properties after oil aging than the carbon black-loaded stocks referred to previously. The optimum loading of magnesia was found to be 100 phr (Recipe A-23), as shown by data in Tables 3 and 4. While more than this amount produced higher tensile strengths, both elongation and hardness were adversely affected. Reducing the magnesia content below this level produced very

[7] *The Activator*, Vol. 9, No. 1, Mar., 1949, New Jersey Zinc Co.

TABLE 1. THE EFFECT OF HAF BLACK ON THE AGING PROPERTIES OF NITRILE RUBBER

Recipe No:	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8
Nitrile Rubber (Hycar 1001)	100	100	100	100	100	100	100	100
HAF Black	40	40	60	80	60	60	80	80
Zinc oxide	5	5	5	5	5	5	5	5
Stearic acid	1	1	1	1	1	1	1	1
Tetramethylthiuram disulfide	3	3	3	3	3	3	3	3
Benzothiazyl disulfide	1	1	1	1	1	1	1	1
Dibutyl sebacate	–	–	–	–	10	10	20	20
Phenyl-beta-naphthylamine	–	3	3	3	3	3	3	3
Cure: 60 minutes at 298° F.								
Original Properties								
Tensile strength, psi.	4180	4100	4220	4270	3450	3300	3300	2970
Elongation, per cent.	490	530	370	270	470	560	310	380
Hardness, Shore A	66	64	73	82	64	55	73	67
Physical Properties After Air Aging at 350° F. for 51-1/2 Hours								
Tensile strength, psi.	670	670	670	730	590	650	690	760
Elongation, per cent.	20	20	20	20	10	20	10	20
Hardness, Shore A	93	91	95	97	96	96	99	100
Physical Properties After Aging in Turbo Oil-15 at 350° F. for 72 Hours								
Tensile Strength, psi.	990	1170	1280	990	1040	1020	1070	1170
Elongation, per cent.	200	230	160	100	160	160	100	110
Hardness, Shore A	57	57	66	75	68	68	78	80
Swell, per cent.	11.8	9.9	9.5	8.0	1.7	–4.2	1.3	–4.1
Crack Resistance	Cracked	Cracked	Cracked	Cracked	Cracked	Cracked	Cracked	Cracked
Physical Properties After Aging in Turbo Oil-15 at 350° F. for 156 Hours								
Tensile strength, psi.	780	890	1020	830	840	700	850	680
Elongation, per cent.	160	160	120	70	120	90	70	50
Hardness, Shore A	61	62	71	78	73	75	83	85
Swell, per cent.	11.2	8.9	8.6	7.6	0.6	–5.4	1.1	–5.0
Crack Resistance	Cracked	Cracked	Cracked	Cracked	Cracked	Cracked	Cracked	Cracked

TABLE 2. THE EFFECT OF LOW LOADINGS OF VARIOUS CARBON BLACKS ON THE AGING PROPERTIES OF NITRILE RUBBER

		Original Physical Properties			Physical Properties After Air Aging 72 Hours at 350° F.			Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350° F.				Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350° F.			
Recipe No.	Type of Carbon Black	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.
A-49	MPC	59	580	2700	94	20	760	11.4	48	220	400	11.3	52	160	310
A-50	EPC	58	520	2250	93	20	700	12.3	48	210	375	11.7	51	140	270
A-51	SRF	55	610	2200	88	20	670	16.8	42	250	375	11.2	51	200	310
A-52	FF	56	590	2450	91	20	625	14.4	45	200	280	11.4	55	190	375
A-53	MT	53	570	1250	90	20	700	14.2	38	270	175	12.2	46	200	130
A-54	FT	53	680	1670	91	20	620	13.5	38	300	200	12.3	46	250	250

Base Recipe:

Ingredients	Parts by Weight
Nitrile rubber (Hycar 1001)	100
Zinc oxide	5
Stearic acid	1.5
Carbon black	25
Tetramethylthiuram disulfide	3
Phenyl-beta-naphthylamine	3

Cure: 30 minutes at 310° F.

Note: All samples failed the 180-degree bend test for crack resistance after 72 hours' aging in either air or oil.

TABLE 3. THE EFFECT OF ZINC OXIDE AND MAGNESIA ON THE AGING PROPERTIES OF NITRILE RUBBER

Recipe No.	Fillers	Loading phr	Original Physical Properties: Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350°F.: Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Crack Resistance	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350°F.: Swell, per cent.	Hardness, Shore A	Elongation, per cent	Tensile Strength, psi	Crack Resistance
A-19	Zinc oxide	5	42	550	325	18.4	36	210	50	Cracked	15.2	43	180	30	Cracked
A-20	Zinc oxide	100	58	580	700	15.2	55	300	500	Cracked	13.9	62	160	530	Cracked
A-21	Magnesia (ELC)*	5	45	500	340	24.4	39	140	60	Cracked	22.2	42	100	20	Cracked
A-22	Zinc oxide Magnesia (ELC)	5 5	46	520	460	24.0	39	170	90	Cracked	24.4	42	140	10	Cracked
A-23	Zinc oxide Magnesia (ELC)	5 100	76	360	2125	17.0	73	200	2425	Crazed	17.7	73	160	2400	Cracked
A-69	Zinc oxide Magnesia (ELC)	5 25	47	670	1160	24.4	48	180	140	Crazed	23.5	55	20	160	Cracked
A-70	Zinc oxide Magnesia (ELC)	25 25	49	600	1325	23.6	50	200	220	Crazed	19.7	60	80	240	Cracked
A-71	Zinc oxide Magnesia (ELC)	50 25	50	610	1480	19.7	54	240	280	Crazed	20.2	59	130	240	Cracked
A-72	Zinc oxide Magnesia (ELC)	50 50	68	620	1580	19.2	62	240	590	Crazed	15.9	78	30	380	Cracked
A-68	Zinc oxide Magnesia (ELC)	5 50	57	640	1670	20.4	55	250	440	Crazed	20.0	65	140	330	Cracked

Base Recipe:

Ingredients	Parts by Weight
Nitrile rubber (Hycar 1001)	100
Stearic acid	1.5
Sulfur	0.5
Tetramethylthiuram disulfide	0.25
Zinc oxide	As indicated
Magnesia (ELC)	As indicated

* Cure: 60 minutes at 298°F.

* Extra-light calcined magnesia, Michigan Chemical Co.

little gain in elongation and considerable loss in tensile strength.

The apparent discrepancy in results for Recipe A-23 in Tables 3 and 4 is attributed to the method of aging. Initial studies were conducted by placing test tubes, containing rubber samples and oil, in a circulating-air oven; while in subsequent tests, aging was performed in an aluminum-block heater. The latter method, which has been described previously, proved to be an excellent method for obtaining reproducible aging results with rubber and related materials.

The exact mechanism by which magnesia functions as a reinforcing agent in nitrile rubber is not known. It is believed that a strong chemical bond is formed between magnesia and the rubber, and this linkage apparently has much greater thermal stability than carbon black-rubber bonds. Subsequent studies with magnesia and nitrile rubber systems have been reported by others.[8] This work has confirmed the utility of magnesia as a filler for high-temperature oil-resistant nitrile rubber, but has not attempted to explain the nature of the reinforcing phenomenon.

Other Non-Black Fillers Tried

On the basis of the excellent aging results attained with magnesia, exploratory studies were conducted with several other non-black fillers. These studies were of a screening nature, and no attempts were made to develop optimum recipes for these materials. Data in Table 5 show that none of these fillers exhibited the phenomenon observed with magnesia for improving crack resistance and retention of physical properties in Turbo Oil-15 at 350° F. Thus, in further compounding research with nitrile rubber for this application, magnesia was selected as the standard filler.

Curing Systems Investigated

Various curing systems were tried in an effort to improve the crack resistance of the magnesia-loaded compound (Recipe A-23). Since low-sulfur and non-sulfur curing agents are widely reported to give vulcanizates having superior aging properties, a number of curing agents of this general type were investigated. The results of this study are shown in Table 6. In the sulfur-containing systems, higher tensile strengths were obtained with greater amounts of available sulfur, but this improvement was not persistent in the oil-aged results.

Sulfurless curatives (such as calcium oxide, cadmium oxide, litharge, and dinitrobenzene) produced vulcanizates with aging properties similar to those obtained with conventional systems, but none that were better. Attempts also were made to attain better properties with peroxide-type curatives (such as *tertiary*-butyl hydroperoxide, diisopropylbenzene monohydroperoxide, paramethane hydroperoxide, and cumene hydroperoxide). Although data are not shown on this point, the aging characteristics of these vulcanizates were considerably inferior to those obtained with sulfur-containing systems.

[8] "Hycar Technical Newsletter," Vol. 3, Dec., 1954, p. 29. B. F. Goodrich Chemical Co.

TABLE 4. THE EFFECT OF VARIOUS LOADINGS OF MAGNESIA ON NITRILE RUBBER

Recipe No.	Magnesia (ELC) Loading, phr	Original Physical Properties: Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350° F.: Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Crack Resistance	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350° F.: Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Strength, psi.	Crack Resistance
A-23	100	77	410	1810	17.8	77	250	1790	Crazed	16.2	83	130	1240	Cracked
A-123	125	91	300	2530	21.1	90	130	2280	Crazed	18.8	88	80	1440	Cracked
A-124	150	94	290	2790	18.0	91	100	2480	Crazed	17.9	94	50	1460	Cracked
A-125	175	100	260	3210	16.1	99	120	3130	Crazed	16.7	100	50	1980	Crazed

Base Recipe:

Ingredients	Parts by Weight
Nitrile rubber (Hycar 1001)	100
Zinc oxide	5
Stearic acid	1.5
Sulfur	0.5
Tetramethylthiuram disulfide	0.25
Magnesia (ELC)	As indicated

Cure: 60 minutes at 298°F.

TABLE 5. THE EFFECT OF NONBLACK FILLERS ON THE AGING PROPERTIES OF NITRILE RUBBER

Recipe No.	Fillers	Loading, phr	Original Physical Properties: Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350° F.: Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Crack Resistance	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350° F.: Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Crack Resistance
A-88	Alumina hydrate	50	60	740	2070	10.6	75	170	580	Cracked	9.3	78	130	480	Cracked
A-89	Alumina hydrate	100	98	600	2170	6.0	99	100	1650	Cracked	3.0	99	10	1100	Cracked
A-105	Aluminum oxide	100	65	540	370	12.6	58	200	130	Cracked	11.7	70	10	310	Cracked
A-117	Aluminum oxide	150	73	600	350	12.1	68	190	230	Cracked	10.4	73	40	400	Cracked
A-92	Aluminum silicate	50	51	600	475	13.5	55	200	100	Cracked	11.9	71	10	430	Cracked
A-93	Aluminum silicate	100	60	730	750	11.3	64	250	250	Cracked	10.5	77	20	330	Cracked
A-99	Barytes	100	55	570	330	13.2	52	130	50	Cracked	12.0	64	10	160	Cracked
A-111	Barytes	150	56	680	310	10.7	57	190	120	Cracked	9.8	66	10	320	Cracked
A-106	Calcium carbonate	100	64	720	1150	14.2	54	330	150	Cracked	12.8	77	10	340	Cracked
A-118	Calcium carbonate	150	74	700	1120	14.0	59	380	300	Cracked	13.0	67	130	260	Cracked
A-102	Dixie Clay*	100	73	670	2120	10.5	75	100	1040	Cracked	9.9	83	50	530	Cracked
A-114	Dixie Clay	150	80	390	1630	8.6	81	70	1410	Cracked	7.9	88	40	760	Cracked
A-84	Hydrated silica	50	51	740	2490	13.2	80	190	930	Cracked	12.0	85	100	590	Cracked
A-86	Hydrated silica	100	96	650	2450	6.8	98	20	2160	Cracked	6.3	100	10	1730	Cracked
A-101	Light precipitated chalk	100	66	580	600	13.5	55	240	120	Cracked	12.3	66	10	220	Cracked
A-113	Light precipitated chalk	150	78	520	660	12.0	69	220	330	Cracked	11.1	75	60	430	Cracked
A-103	Litharge	100	57	720	770	73.5	70	10	250	Cracked	67.3	85	10	530	Cracked
A-115	Litharge	150	61	800	1120	127.7	65	0	30	Cracked	117.8	75	10	240	Cracked
A-94	Magnesium carbonate	50	48	710	1350	16.0	65	70	200	Cracked	16.5	80	20	580	Cracked
A-95	Magnesium carbonate	100	50	760	1160	22.9	45	300	120	Cracked	22.4	54	100	120	Cracked
A-104	Mica	100	78	540	920	10.7	80	80	500	Cracked	11.1	80	70	540	Cracked
A-116	Mica	150	85	290	940	9.3	84	60	880	Cracked	8.4	89	30	870	Cracked
A-85	Calcium silicate	50	60	570	1675	12.8	72	180	580	Cracked	12.8	72	130	430	Cracked
A-87	Calcium silicate	100	78	585	2085	11.6	88	130	1030	Cracked	10.5	94	60	670	Cracked
A-100	Titanium dioxide	100	56	670	860	14.5	54	240	170	Cracked	12.8	63	40	230	Cracked
A-112	Titanium dioxide	150	60	730	980	12.6	60	380	320	Cracked	12.1	70	130	310	Cracked
A-216	Aerosil†	20	58	710	1680	14.9	68	190	330	Cracked	13.9	77	20	370	Cracked
A-223	Aerosil	50	83	640	3010	12.7	90	160	900	Crazed	11.0	94	80	630	Cracked
A-217	Aerosil	100	100	340	4230	10.5	100	30	1420	Cracked	9.7	99	20	1330	Cracked

Base Recipe:

Ingredients	Parts by Weight
Nitrile rubber (Hycar 1001)	100
Zinc oxide	5
Stearic acid	1.5
Sulfur	0.5
Tetramethylthiuram disulfide	0.25
Filler	As indicated

Cure: 60 minutes at 298 F.

*Kaolin clay, R. T. Vanderbilt Co.
†Fine particle-size silica. Now trade marked Cab-o-sil, Godfrey L. Cabot, Inc.

TABLE 6. A STUDY OF LOW-SULFUR AND NONSULFUR CURING SYSTEMS IN A NITRILE RUBBER RECIPE

Recipe No.	Curing System, Ingredient	Concentration, phr	Original Physical Properties			Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350°F.					Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350°F.				
			Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Crack Resistance	Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Crack Resistance
A-23	Tetramethylthiuram disulfide	0.25	77	630	1875	17.8	77	250	1790	Crazed	16.2	83	130	1240	Cracked
	Sulfur	0.5													
A-126	Tetramethylthiuram disulfide	4.0	80	580	3240	23.6	74	310	1180	Crazed	22.6	84	170	940	Cracked
A-127	Tetramethylthiuram disulfide	2.0	80	560	3130	25.9	79	260	1490	Cracked	23.9	83	130	1100	Cracked
	Selenium	1.0													
A-128	Tetramethylthiuram disulfide	2.0	79	580	2610	29.2	77	210	1270	Cracked	24.1	84	130	830	Cracked
	Tellurium	1.0													
A-133	Tetramethylthiuram disulfide	3.0	80	710	3330	26.2	73	370	1480	Cracked	23.9	85	170	910	Cracked
	Tellurium	0.5													
A-134	Tetramethylthiuram disulfide	3.0	82	690	3090	24.0	75	300	1250	Crazed	22.6	85	160	900	Cracked
	Tellurium	1.0													
A-135	Tetramethylthiuram disulfide	3.0	83	630	3100	22.0	78	390	1560	Crazed	22.0	85	200	1060	Cracked
	Selenium	0.3													
A-136	Tetramethylthiuram disulfide	3.0	82	610	2800	20.9	80	290	1280	Crazed	20.1	87	140	940	Cracked
	Selenium	0.6													
A-137	Litharge	1.5	80	530	2130	24.5	75	250	1510	Crazed	23.7	83	130	1010	Cracked
	Sulfur	0.5													
	Benzothiazyl disulfide	1.0													
A-110	Litharge	5.0	75	870	1960	30.0	61	310	770	Crazed	29.9	88	30	460	Cracked
A-168	Benzothiazyl disulfide	4.0	82	590	3420	24.7	72	390	1220	Crazed	24.4	82	170	700	Cracked
	Manganese dioxide	10.0													
	p-Quinonedioxime	2.0													
A-169	Tetramethylthiuram disulfide	3.0	81	600	1970	21.1	78	190	1260	Crazed	18.8	86	100	950	Cracked
	N-cyclohexyl-α-benzo-thiazyl sulfenamide	2.0													
A-186	α-Mercapto-thiazoline	2.0	75	880	1430	26.6	75	420	1490	Crazed	25.5	89	150	930	Cracked
A-187	Butyraldehyde-aniline reaction product	1.0	82	700	2870	25.3	75	340	1210	Cracked	24.2	86	160	870	Cracked
	Tetramethylthiuram disulfide	3.0													
A-188	Tellurium diethyldithiocarbamate	3.0	82	660	2370	21.5	81	260	1380	Cracked	20.8	89	140	910	Cracked
A-200	Cadmium oxide	5.0	85	540	1880	24.2	78	240	1270	Crazed	26.0	85	100	660	Cracked
A-201	Calcium oxide	5.0	81	570	1890	24.3	76	310	1530	Crazed	26.1	82	120	900	Cracked
A-202	Litharge	10.0	84	640	2450	22.4	90	70	1330	Crazed	20.9	97	30	880	Cracked
	Dinitrobenzene	4.0													

Base Recipe:

Ingredients	Parts by Weight
Nitrile rubber (Hycar 1001)	100
Magnesia (ELC)	100
Zinc oxide (except in A-168)	5
Stearic acid	1.5
Curing agents	As shown

Cure: 60 minutes at 298°F.

TABLE 7. THE EFFECT OF COMMERCIAL AND EXPERIMENTAL ANTIOXIDANTS ON THE AGING PROPERTIES OF NITRILE RUBBER

Recipe No.	Antioxidant	Composition of Antioxidant	Original Physical Properties			Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350 F.				Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350 F.			
			Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.
A-34	None (control)	—	62	490	4350	6.5	52	200	1075	13.1	61	130	650
A-36	AgeRite Alba†	Hydroquinone monobenzyl ether	58	590	4290	12.2	49	180	665	17.1	62	130	650
A-37	AgeRite Hipar†	Mixture of phenyl-beta-naphthylamine, p-isopropoxy diphenylamine, and diphenyl-p-phenylene diamine	58	590	4125	11.6	50	160	590	11.5	58	120	610
A-38	AgeRite Stalite†	Heptylated diphenylamine	60	540	4200	10.2	50	170	710	10.6	59	130	670
A-39	Aminox‡	Reaction product of diphenylamine and acetone	60	590	4400	12.7	49	190	650	10.7	60	130	650
A-40*	Parazone	p-Phenyl-phenol	57	530	4000	11.8	49	180	680	11.4	58	140	650
A-41	Santovar A§	Alkylated polyhydroxy phenol	57	650	3275	10.8	55	60	310	7.1	85	20	390
A-42	Santowhite§	Alkylated phenol sulfide	58	560	4050	12.3	50	160	680	10.4	62	120	620
A-43	Wingstay S¶	Styrenated phenol	60	560	3975	10.8	51	170	760	10.9	61	120	575
A-44*	Flectol H	Condensation product of acetone and aniline	58	570	4000	11.6	47	210	875	12.2	58	150	720
A-45	Neozone A‖	Phenyl-alpha-naphthylamine	59	540	3875	11.0	55	190	840	10.8	60	120	550
A-46*	PDA-10	Poly diaryl amine	62	540	4050	11.2	53	210	1025	11.9	61	130	620
A-47	Santoflex AW§	6-Ethoxy-1,2-dihydro-2,2,4-trimethyl-quinoline	59	630	4000	11.0	53	200	990	11.6	60	130	650
A-48	2,5-dicyclohexyl hydroquinone	—	63	610	3900	9.9	68	130	350	7.7	80	85	350
A-55*	t-Butyl catechol	—	65	600	3625	14.4	49	210	625	12.5	56	140	525
A-56*	Hydroquinone	—	64	640	3575	14.4	58	180	350	11.0	62	150	550
A-57	Versene**	Tetrasodium salt of ethylene-diamine tetra-acetic acid	67	470	3950	14.8	54	180	740	9.8	60	140	600
A-58	Disodium lead versenate	—	67	450	3850	15.7	52	160	500	12.5	62	140	600
A-59*	Pyrogallol	—	66	720	2500	13.2	54	240	930	11.6	56	160	780
A-60	Aniline	—	64	530	3800	13.9	51	180	600	11.0	60	150	550
A-61	Nitrophenol	—	65	450	3325	11.2	61	120	600	9.0	68	80	575
A-62	p-Benzyl-aminophenol	—	63	650	2980	14.0	51	210	590	12.5	55	160	575
A-63	Resorcinol	—	64	560	4120	12.8	54	160	500	11.4	62	130	575
A-64	2-hydroxyquinoline	—	64	480	4010	12.0	57	150	525	11.8	59	130	550

*Improved crack resistance.

Base Recipe:

Ingredients	Parts by Weight
Nitrile rubber (Hycar 1001)	100
Zinc oxide	5
Stearic acid	1.5
HAF black	40
Tetramethylthiuram disulfide	3
Antioxidant	3

Cure: 30 minutes at 310°F.

†R. T. Vanderbilt Co.
‡Naugatuck Chemical Division, United States Rubber Co.
§Rubber chemicals department, Monsanto Chemical Co.
¶Chemical division, Goodyear Tire & Rubber Co.
‖Elastomers department, E. I. du Pont de Nemours & Co., Inc.
**Bersworth Chemical Co.

TABLE 8. THE EFFECT OF PHENOLIC COMPOUNDS ON THE AGING PROPERTIES OF NITRILE RUBBER

Recipe No.	Phenolic Compound	Original Physical Properties: Hardness, Shore A	Original Physical Properties: Elongation, per cent.	Original Physical Properties: Tensile Strength, psi.	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350°F.: Swell, per cent.	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350°F.: Hardness, Shore A	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350°F.: Elongation, per cent.	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350°F.: Tensile Strength, psi.	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350°F.: Crack Resistance	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350°F.: Swell, per cent.	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350°F.: Hardness, Shore A	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350°F.: Elongation, per cent.	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350°F.: Tensile Strength, psi.	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350°F.: Crack Resistance
A-23	None	77	410	1810	17.8	77	250	1790	Crazed	16.2	83	130	1240	Cracked
A-151	p-Phenyl phenol	79	530	2340	25.7	76	230	1530	Crazed	22.6	85	140	940	Cracked
A-152	p-Tert-amyl phenol	78	540	2210	25.4	77	270	1680	Crazed	24.0	85	150	1120	Cracked
A-153	o-Amyl phenol	78	440	1960	23.9	81	220	1530	Crazed	22.7	85	140	1060	Cracked
A-154	Nonyl phenol	78	540	2280	23.9	80	210	1580	Crazed	22.2	86	140	1180	Cracked
A-155	Phenol	77	570	2120	24.0	80	250	1750	Crazed	23.7	85	150	1190	Cracked
A-156	Triphenyl phosphite	80	570	2180	25.6	78	250	1410	Crazed	24.1	86	140	990	Cracked
A-183	Phloroglucinol	74	650	1850	26.2	72	280	1570	Crazed	25.5	81	130	880	Cracked
A-184	Catechol	73	690	2630	29.5	72	320	1400	Cracked	28.1	85	120	730	Cracked
A-185	Di-tert-butyl-paracresol	76	620	1670	25.4	74	260	1280	Crazed	23.1	87	90	740	Cracked

Base Recipe: Ingredients	Parts by Weight
Nitrile rubber (Hycar 1001)	100
Magnesia (ELC)	100
Zinc oxide	5
Stearic acid	1.5
Sulfur	0.5
Tetramethylthiuram disulfide	0.25
Phenolic compound	3

Cure: 60 minutes at 298°F.

TABLE 9. THE EFFECT OF LARGE AMOUNTS OF ANTIOXIDANT ON THE AGING PROPERTIES OF NITRILE RUBBER

Recipe No.	Antioxidant	Antioxidant Concentration, phr	Original Physical Properties: Hardness, Shore A	Original Physical Properties: Elongation, per cent.	Original Physical Properties: Tensile Strength, psi.	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350°F.: Swell, per cent.	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350°F.: Hardness, Shore A	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350°F.: Elongation, per cent.	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350°F.: Tensile Strength, psi.	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350°F.: Crack Resistance	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350°F.: Swell, per cent.	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350°F.: Hardness, Shore A	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350°F.: Elongation, per cent.	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350°F.: Tensile Strength, psi.	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350°F.: Crack Resistance
A-23	None	–	77	630	1875	17.8	77	250	1790	Crazed	16.2	83	130	1240	Cracked
A-181	Pyrogallol	3	74	630	2450	22.3	74	220	1710	Crazed	20.2	86	100	880	Cracked
A-138	Pyrogallol	10	90	510	3090	14.8	91	110	1890	Crazed	13.1	96	60	1220	Cracked
A-139	Pyrogallol	15	95	470	2840	13.9	94	100	2160	Crazed	12.6	98	40	1410	Cracked
A-180	o-Cresol	3	75	700	1660	25.4	76	310	1430	Crazed	23.2	82	150	910	Cracked
A-140	o-Cresol	10	72	750	1530	22.6	75	340	1560	Crazed	22.4	85	170	980	Cracked
A-141	o-Cresol	15	68	750	1680	18.1	76	340	1230	Crazed	19.3	84	170	830	Cracked
A-182	Polymerized trimethyldihydroquinoline (AgeRite Resin D)	3	76	670	1740	25.1	75	290	1560	Crazed	22.3	85	150	860	Cracked
A-142	Polymerized trimethyldihydroquinoline	10	77	630	1860	18.4	73	320	1750	Crazed	16.9	81	190	1340	Cracked
A-143	Polymerized trimethyldihydroquinoline	15	76	720	1460	16.5	71	400	1520	Crazed	14.9	79	210	1180	Cracked

Base Recipe: Ingredients	Parts by Weight
Nitrile rubber (Hycar 1001)	100
Magnesia (ELC)	100
Zinc oxide	5
Stearic acid	1.5
Sulfur	0.5
Tetramethylthiuram disulfide	0.25
Antioxidant	As shown

Cure: 60 minutes at 298°F.

TABLE 10. THE EFFECT OF ADDING ANTIOXIDANT TO A NITRILE RUBBER COMPOUND AND TO THE AGING OIL

Recipe No.	Antioxidant in Rubber*	Loading, phr	Antioxidant in Oil, per cent.	Original Physical Properties			Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350° F.					Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350° F.				
				Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Crack Resistance	Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Crack Resistance
A-23	None	–	0	77	410	1810	17.8	77	250	1790	Crazed	16.2	83	130	1240	Cracked
A-180	o-Cresol	3	0	75	700	1660	25.4	76	310	1430	Crazed	23.2	82	150	910	Cracked
	o-Cresol	3	0.15	–	–	–	23.6	78	290	1400	Cracked	22.0	83	160	970	Cracked
	o-Cresol	3	1	–	–	–	23.8	75	320	1450	Crazed	21.9	87	120	830	Cracked
A-181	Pyrogallol	3	0	74	630	2450	22.3	74	220	1710	Crazed	20.2	86	100	880	Cracked
	Pyrogallol	3	0.15	–	–	–	14.0	82	150	1410	Crazed	13.7	88	80	950	Cracked
	Pyrogallol	3	1	–	–	–	17.9	93	80	1830	Cracked	17.4	98	40	1640	Cracked
A-171	Parazone	3	0	80	540	1910	23.6	77	220	1310	Crazed	21.4	83	110	930	Cracked
	Parazone	3	0.15	–	–	–	23.0	78	230	1380	Crazed	21.8	85	120	900	Cracked
	Parazone	3	1	–	–	–	25.9	76	240	1370	Crazed	22.9	84	120	870	Cracked
A-172	Flectol H	3	0	80	550	1980	20.2	78	210	1510	Crazed	18.5	84	130	1020	Cracked
	Flectol H	3	0.15	–	–	–	20.2	77	250	1440	Crazed	20.8	83	130	1130	Cracked
	Flectol H	3	1	–	–	–	20.3	71	210	1150	Crazed	24.4	79	160	1190	Crazed
A-159	o-Cresol	20.1	0	66	670	2020	15.1	76	310	1010	Crazed	12.5	83	170	820	Cracked
	o-Cresol	20.1	0.15	–	–	–	12.5	74	330	1140	Crazed	13.5	87	150	750	Cracked
	o-Cresol	20.1	1	–	–	–	15.0	76	350	1260	Crazed	13.5	87	150	740	Cracked
A-160	Pyrogallol	20.1	0	98	350	2820	10.4	99	60	1930	Cracked	9.6	100	30	1610	Cracked
	Pyrogallol	20.1	0.15	–	–	–	7.8	100	40	1740	Cracked	8.1	99	30	1700	Cracked
	Pyrogallol	20.1	1	–	–	–	9.4	100	30	2270	Cracked	10.3	100	30	2250	Cracked
A-161	Parazone	20.1	0	69	610	2180	13.3	70	290	770	Crazed	11.8	80	130	590	Cracked
	Parazone	20.1	0.15	–	–	–	12.0	71	310	830	Crazed	11.5	88	80	500	Cracked
	Parazone	20.1	1	–	–	–	14.3	66	330	940	Crazed	17.0	84	80	480	Cracked
A-162	Flectol H	20.1	0	79	550	1990	13.6	73	310	1350	Crazed	12.3	79	210	1180	Cracked
	Flectol H	20.1	0.15	–	–	–	13.2	74	310	1430	Crazed	13.2	80	180	1110	Cracked
	Flectol H	20.1	1	–	–	–	11.8	71	360	1440	Crazed	16.8	76	240	1390	Crazed

Base Recipe:

Ingredients	Parts by Weight
Nitrile rubber (Hycar 1001)	100
Magnesia (ELC)	100
Zinc oxide	5
Stearic acid	1.5
Sulfur	0.5
Tetramethylthiuram disulfide	0.25

Cure: 60 minutes at 298°F.

*Identity of materials as shown in Table 7.

From this study it appears very unlikely that any significant improvement can be obtained in the aging characteristics of nitrile rubber by further work with curatives. It can be assumed that the vulnerability to oxidation of the double-bonds of this type of polymer is a much more serious factor in its degradation than is the nature of the cross-links formed by vulcanization.

Antioxidants' Effect Limited at High Temperatures

An intensive effort was made to protect the nitrile rubber double-bonds with antioxidants. The effectiveness of several typical rubber antioxidants is illustrated in Table 7. A carbon black filler was used to magnify differences. None of the conventional antioxidants imparted significant improvement in the aging qualities of the rubber, although Parazone,[9] Flectol H,[10] and PDA-10[11] appeared slightly more effective than the others in retarding cracking.

Experimental antioxidants also were examined, including shortstopping agents for polymerization and sequestering agents. Since a considerable number of undesirable cross-links are formed during the aging of rubber, as demonstrated most dramatically by a decline in elongation, it was thought that materials which tend to limit and/or stop polymer growth might block the formation of undesirable cross-links during aging.

A number of compounds selected for this study were phenolic in nature. Some commercial antioxidants fit into this general class of organic compounds, and a number of derivatives of this type have been used as antioxidants for oil. Aging results presented here, however, disclose that these experimental materials were not particularly effective at 350° F., although they were as effective as most of the conventional antioxidants. Pyrogallol, hydroquinone and t-butyl catechol appeared approximately equal to the more efficient commercial antioxidants for improving crack resistance.

Similar results (Table 8) were obtained with phenolic-type compounds in the standard magnesia-filled composition. That is, the aging properties were not significantly improved by the addition of these antioxidants. Table 9 shows that even when the concentration of several antioxidants was increased to as high as 15 phr, there was no improvement in crack resistance. This higher amount of AgeRite Resin D appeared to improve the balance of elongation and tensile strength of the oil-aged composition slightly, but cracking still persisted.

It was reasoned that adding antioxidant to both the rubber and oil should help overcome the cracking problem. Table 10 demonstrates that some improvement in crack resistance was obtained when the greatest amount of Flectol H was used. Thus, 20 phr of Flectol H in the rubber and 1% Flectol H in the oil reduced the crack rating from "cracked" to "crazed" for samples examined after 168 hours in Turbo Oil-15 at 350° F. It is not known whether these are practical amounts to use in either the rubber or the oil, but these data illustrate that probably only minor improvements can be expected by employing such appreciable higher-than-usual amounts of antioxidant.

It is obvious that when antioxidant is put in the rubber, it can be extracted readily by the leaching action of the oil. It apparently is also true that exposure of the oil to air permits loss of antioxidant by volatilization and oxygen attack. Protection is, therefore, limited by the permanence of the antioxidant. In lubrication systems which contain air, this has been shown to be a particularly acute problem.

Plasticizers Ineffective

It was thought that one method to prevent cracking might be to increase the elongation of the rubber by incorporation of a plasticizer, preferably one that would not be extracted by the aging oil. The effect of adding so-called non-extractable plasticizers to the standard magnesia recipe is shown in Table 11. While some of these contributed toward higher elongations after aging, with a foreseen loss of tensile strength, this shift in the balance of properties had little or no effect on crack resistance.

While plasticizers are often included in rubber compositions to reduce swell, it is interesting to note that very few of the materials contributed in this direction, and those that did produced undesirable losses in other properties. In general, the swell of the non-plasticized standard stock (Recipe A-23) was not excessive; hence, plasticizers are not necessary to control this property.

Effect of Acrylonitrile Content on Oil-Aging Characteristics

A study was conducted to determine the effect of the acrylonitrile content of the base copolymer on the aging properties of a magnesia-filled formulation. Several rubbers, ranging in acrylonitrile content from 18 to 60% were included in this study. Although the rubbers with low acrylonitrile content (18 to 35%) were known to possess poorer oil resistance, it was hoped that plasticization from swelling would improve crack resistance. Aging results (Table 12) disclosed that these compounds softened, swelled excessively, and exhibited poor retention of stress-strain properties. The improvement sought in crack resistance did not materialize.

Two experimental rubbers, containing 55 and 60% acrylonitrile, were examined to determine whether a reduction in the butadiene content, which would reduce the number of double-bonds available for oxidation, would improve crack resistance. As indicated in Table 12, no improvement was attained, although these rubbers did display low swell and good retention of tensile strength. Hardness and elongation values, however, were very poor after oil aging at 350°F. for only 72 hours.

Thus it was established that those rubbers containing 40-45% acrylonitrile offer the best balance of hot-oil aging characteristics.

Other Studies Conducted with Nitrile Rubber

Results are not shown for a number of other investigations carried out in this program, owing to space con-

[9] Elastomers department, E. I. du Pont de Nemours & Co., Inc.
[10] Rubber chemicals department, Monsanto Chemical Co.
[11] Benson Process Engineering Co.

TABLE 11. THE EFFECT OF NONEXTRACTIBLE PLASTICIZERS ON THE AGING PROPERTIES OF NITRILE RUBBER

Recipe No.	Additive	Loading, phr	Original Physical Properties: Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350° F.: Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Crack Resistance	Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350° F.: Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Crack Resistance
A-23	None	–	77	630	1875	17.8	77	250	1790	Crazed	16.2	83	130	1240	Cracked
A-243	ODN Plasticizer*	3	73	570	2460	16.8	70	330	1120	Crazed	14.7	76	190	800	Cracked
A-221	ODN Plasticizer	10	59	750	2270	8.5	68	400	1060	Crazed	7.5	77	240	775	Cracked
A-222	ODN Plasticizer	5	65	690	2390	13.0	69	350	1050	Crazed	11.7	79	220	750	Cracked
A-198	Hycar 1012 × 41†	10	79	630	1770	24.0	75	280	1400	Crazed	24.4	82	190	1110	Cracked
A-226	Hycar 1012 × 41	15	66	780	2020	18.5	64	420	840	Crazed	16.3	76	280	730	Cracked
A-225	Hycar 1012 × 41	20	61	850	1690	16.3	61	390	670	Crazed	15.2	73	280	950	Cracked
A-199	Hycar 1011 × 15†	10	82	500	1850	25.0	78	250	1380	Crazed	23.7	84	120	850	Cracked
A-191	Paraplex G-25‡	10	78	660	1980	23.1	78	330	860	Crazed	26.3	91	150	630	Cracked
A-192	Glyptal Plasticizer 2557**	10	76	660	2020	21.3	77	320	810	Crazed	23.1	90	160	650	Cracked

Base Recipe:

Ingredients	Parts by Weight
Nitrile rubber (Hycar 1001)	100
Magnesia (ELC)	100
Zinc oxide	5
Stearic acid	1.5
Sulfur	0.5
Tetramethylthiuram disulfide	0.25
Plasticizer	As indicated

Cure: 60 minutes at 298° F.

* Octadecene nitrile, Harwick Standard Chemical Co.
† Liquid copolymers of nitrile rubber, B. F. Goodrich Chemical Co.
‡ Polymeric plasticizer, Rohm & Haas Co.
** Polymeric plasticizer, General Electric Co.

siderations. It appears appropriate, however, to mention a few of the additional ideas explored in an effort to enhance the hot-oil resistance of nitrile rubber.

Processing aids, softeners, and other selected additives were investigated in an endeavor to improve the oil-aging properties of magnesia-filled stocks. None of these materials was found to be effective for reducing cracking or for upgrading other aging characteristics.

A study of curing conditions indicated that the curing cycle had negligible effect on oil-aging qualities so long as a reasonably tight cure was obtained. A curing cycle of 60 minutes at 298° F. was employed arbitrarily, although similar conditions were found to work equally well.

Mention has been made that nitrile rubber is vulnerable to oxidative attack because of the double-bonds in the butadiene portion of this-type polymer. It was reasoned, therefore, that reducing the extent of this unsaturation might improve its resistance to cracking. It was hoped that the amount of unsaturation could be reduced to about the level of butyl rubber, which contains a minimum number of double-bonds for satisfactory vulcanization.

Several additives were tried in an effort to accomplish this change in the polymer. These included a number of thiols, such as thioacetic acid, thioglycolic acid, thiocresol, diisoctyl thiomalate, t-dodecyl mercaptan, and thiomalic acid. In small amounts, some of these appeared to reduce the extent of cracking for aging periods up to 72 hours, but were of questionable value for longer periods. When larger amounts were employed, no advantage was noted. In some instances, hardening and cracking were even more severe than without such additives.

A very cursory study was made to investigate the possibility of reducing the unsaturation of nitrile rubber by partial hydrogenation of conventional nitrile rubbers, using mild hydrogenation conditions,[12] but the product obtained failed in testing because of excessive brittleness. An alternative approach to reducing unsaturation would be to produce a new nitrile polymer having a large proportion of the butadiene replaced by a saturated monomer. The scope of this project, however, did not permit following these leads in order to determine the full benefits which might result from the use of a nitrile-type polymer with unusually low unsaturation.

General Comments on Compounding Materials

The authors wish to comment on the particular materials selected as polymers and compounding ingredients in this study. There is no intent to imply or infer that one supplier's products are superior or inferior to those of another supplier. In general, similar materials from other suppliers might be expected to produce similar results. Another point that needs expressing here is that the poor performance of some of the materials employed should not be taken as an indication that

[12] M. H. Harvey, United States patent No. 2,678,892 (May 18, 1954).

TABLE 12. THE EFFECT OF ACRYLONITRILE CONTENT ON THE AGING PROPERTIES OF NITRILE RUBBER

Recipe No.	Acrylonitrile Content, per cent.	Original Physical Properties			Physical Properties After Aging in Esso Turbo Oil-15 72 Hours at 350° F.					Physical Properties After Aging in Esso Turbo Oil-15 168 Hours at 350° F.				
		Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Crack Resistance	Swell, per cent.	Hardness, Shore A	Elongation, per cent.	Tensile Strength, psi.	Crack Resistance
A-211	60*	100	70	3500	3.5	100	40	3030	Cracked	3.3	97	20	2680	Cracked
A-173	55†	98	170	2180	6.9	96	60	2030	Crazed	6.3	98	30	1530	Cracked
A-157	45†	86	510	1680	27.1	80	270	1320	Crazed	23.3	88	150	1010	Cracked
A-23	42‡	77	630	1875	17.8	77	250	1790	Crazed	16.2	83	130	1240	Cracked
A-175	35‡	81	320	1250	44.2	62	150	490	Cracked	40.1	73	50	300	Cracked
A-177	26‡	73	380	1120	73.5	47	140	260	Crazed	73.3	55	70	140	Cracked
A-178	18‡	65	390	1110	134.3	31	90	80	Crazed	125.1	28	70	25	Cracked

Base Recipe:

Ingredients	Parts by Weight
Nitrile rubber	100
Magnesia (ELC)	100
Zinc oxide	5
Stearic acid	1.5
Sulfur	0.5
Tetramethylthiuram disulfide	0.25

Cure: 60 minutes at 298° F.

* Hycar 1000 x 70, experimental polymer, B. F. Goodrich Chemical Co.
† Experimental polymer produced by Battelle Memorial Institute.
‡ Commercial polymers.

the materials would also be unsatisfactory for other applications. This is because the tests employed are considered to be too severe to serve as a realistic basis for judging the quality of any of the compounding ingredients for use in compositions that have different performance requirements.

Summary and Conclusions

Studies were made to develop a nitrile rubber composition that would perform satisfactorily for 500 hours at 350° F. in a synthetic diester lubricant, Turbo Oil-15. Conventional oil-resistant nitrile rubber compounds cracked and degraded drastically after only 72 hours' exposure to Turbo Oil-15 at 350° F.

A magnesia loaded composition was developed that withstood the severe aging conditions for 168 hours, when surface cracking of the rubber occurred. Extensive compounding studies with curing systems, antioxidants, plasticizers, softeners, and other materials failed to improve the aging characteristics of the magnesia-filled stock.

Acknowledgment

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Tire Operating Temperatures

The National Bureau of Standards has developed a precise, direct method for determining tire operating temperatures. The procedure involves the use of a copper-constantan thermocouple inserted through the tire valve. When the tire is rotated under load, the thermocouple gives a precise measurement of the average contained-air temperature.

Intended for tire research and evaluation studies, the procedure was developed by G. G. Richey, R. H. Hobbs, and R. D. Stiehler, of the NBS, and sponsored by the Federal Facilities Corp., Office of Synthetic Rubber. Methods hitherto used to determine tire operating temperatures have been difficult to carry out or have been of questionable accuracy, the NBS says.

After attempting many alternative methods, the Bureau demonstrated that the temperature indicated by a thermocouple inserted 70% of the tire diameter (or a distance of 6½ inches for a 9.00-20 truck tire) is the average temperature of the air in the tire. The actual distance of 70% of the inside height was chosen to minimize the effect of radiation from the walls and thermal conduction along the wire. The air temperature is substantially the same throughout the torus of air one inch from the tube walls. Close to the base of the tire, however, there are sharp differences.

Differential thermocouples used in the Bureau's studies were connected through copper slip rings to a stationary copper-constantan circuit. Compensating junctions permitted the use of a copper lead wire from the constantan part of the thermocouple to its corresponding slip ring and brush. The negligible potential at the slip rings was verified by a benzoic acid standard reference cell.

Complete details of the study are available in NBS Summary Technical Report 2099.

MEETINGS and REPORTS

Well-Attended WADC Elastomer Conference Shows Polymer Research Progress and Needs

THE Materials Laboratory of the Wright Air Development Center, with the assistance of the University of Dayton held a two-day conference on March 27 and 28 at the Miami Hotel, Dayton, O., for the purpose of aiding the aircraft industry in the solution of critical elastomer problems. Wright Air Development Center, located at the Wright-Patterson Air Force Base near Dayton, is one of the major centers of the Air Force's Air Research and Development Command.

The overall theme of the conference was "Elastomers for Air Weapons," and 105 aircraft, rubber, supplier, and industrial research companies were represented at the conference. More than 40 members of the WADC Materials, Aircraft, Power Plant, Equipment, and Electronic Components Laboratories were present at the meeting, many of whom participated in the program.

E. R. Bartholomew and J. M. Kelble, of the Materials Laboratory, Rubber Products Section, were co-chairmen of the conference. Opening remarks on the morning of March 27 were made by M. R. Graney, dean of the College of Engineering, University of Dayton, and by R. T. Schwartz, chief, Organic Materials Branch, WADC. Dr. Graney welcomed the registrants for the University of Dayton and mentioned that the University was doing contract research work on materials for WADC, an activity which it hoped to expand in the future. Mr. Schwartz welcomed the registrants for WADC and explained that the Organic Materials Branch of the Materials Laboratory included a Rubber Products Section headed by Mr. Bartholomew and a Polymer Section headed by Maj. W. Postelnek.

Session—I

The program on March 27 was entitled "Environments—Compounds—Components." Mr. Bartholomew presided at the morning and afternoon sessions on that day.

"Elastomers—The Achilles Heel," by Lt. Col. H. C. Hamlin, WADC, stressed the 1957 estimate of the elastomers for aircraft service, with special reference to what is wrong with what we have and what we are going to need very soon. Aircraft power plant experts, it was said, are planning now to deal with lubrication systems reaching 500° F. and bulk oil reservoir temperatures of 700-800° F. in the near future. Fuel systems, which may now reach an ambient temperature of about 260° F., will reach and probably pass 400° F., and even fuel cells and sealants are expected to encounter 500° F. temperatures in the near future also.

Elastomers for hydrocarbon fuel cells need much improvement, and a better aircraft tire to withstand increasingly severe service conditions is a must. Exposure to nuclear radiation has been and will continue to be investigated. Exposure to higher radiation doses will require elastomers with greater radiation resistance.

The Department of Defense and the Air Force have long recognized the value of advanced exploratory research as a basic requisite to progress. Four active research areas from which elastomers may receive help were mentioned, as follows: (1) internal structure and properties of matter; (2) the structure and properties of interfaces; (3) new synthetic methods; (4) theoretical and experimental techniques.

The first area is concerned with molecular engineering; the second includes study in solid, liquid, and gaseous phases; the third, special skills to produce a required material; and the fourth, materials research methodology.

In conclusion, Colonel Hamlin said that responsibility for the future of rubber, even for what may currently be strictly military applications, lies as much or more with industry as with the military services; and no research program, however well planned and organized, can be carried to eventual success without the wholehearted guidance and support of industry and our universities and research centers.

"High-Temperature Aircraft Tires," by L. J. Kitchen, Firestone Tire & Rubber Co., first defined a high-temperature tire as one that could be safely heat-soaked at inflation pressure at temperatures above 325° F. Present aircraft tires are approaching temperature limits above which the use of organic fibers is not practical; and it now appears that these tires will have to be made with metal wire tire cord. This use of metal wire will require design changes and possibly changes in load limits, which would mean larger tires and larger tire wells in the aircraft.

There is very little background of experience regarding the properties of elastomers required for satisfactory performance in aircraft tires at elevated temperatures. More information must be obtained quickly so that efforts will not be expended in developing elastomers inherently unsuited for high-temperature tires, or, on the other hand, in discarding elastomers from consideration because they have been screened out by some arbitrary test that may have no relation to performance.

Actual performance of various types of elastomers in aircraft tires at high temperatures may be determined by high-speed landing tests, facilities for which are available at WADC.

"Rubber *versus* Nuclear Environments," by John W. Born, B. F. Goodrich Co., covered in part work done by Goodrich for WADC since 1954. This work included a survey of some 200 vulcanized rubber compounds which resulted in a catalog of radiation effects upon stress-strain properties and led to the discovery of radiation damage inhibitors called antirads. Also, a screening study of 91 potential inhibitors disclosed numerous antirads for natural rubber, some of which were very effective and provided criteria for further development of antirads, and a study of the effects of gamma radiation on the dynamic mechanical properties of representative practical rubber compounds and factory stocks resulted in growing interest in applied research aimed at acquiring aircraft engineering design data.

The effects of irradiation on selected dynamic mechanical properties of rubber were covered in the WADC conference paper.

"Fuels, Lubricants, Hydraulic Fluids—What? Where? How to Retain," was a three-part paper with fuels covered by L. C. Dickey, WADC Power Plant Laboratory; lubricants, by Lt. J. H. Way, also of the Power Plant Laboratory; and hydraulic fluids by F. R. Straus, of the Aircraft Laboratory.

Mr. Dickey set the theme for these three papers when he said that the purpose of presenting information on fuels, lubricants, and hydraulic fluids was to consider their effects on elastomers.

The Air Force's main operational fuel

requirements are for aviation gasoline for reciprocating engines and jet fuel for turbojet and turboprop engines. Rubber parts which were developed to avoid excessive swelling in highly aromatic fuel may shrink and cause leakage when used with a fuel having a low aromatic content, as was the case in 1947 when fuels of low aromatic content replaced those of higher aromatic content. Aviation gasoline with a minimum aromatic content of 10% was specified in 1949, and after 1949 the aromatic minimum requirement was removed from the specification and the heating value requirement relied upon to control aromatic content.

Jet fuel JP-4 properties are now pretty well standardized, but supersonic jet fuel and ramjet fuel for the newer engines are still undergoing development, and the properties specified at present may have to be changed, it was said.

Lieutenant Way explained that esters, mineral oils, silicones and silanes, with suitable additives, have been screened for use as high-temperature lubricants, i.e., for temperatures up to 400° F. Esters and mineral oils are the most promising candidates for high-temperature lubricants, although silicones and silanes have very interesting properties if some of their current defects can be corrected.

In the ester class, diesters, fluoresters, and pentaerythritol esters are the most promising materials. As with mineral oils, the esters have relatively poor low-temperature properties. If the oils must be heated for low-temperature starting, it is quite possible that the low-temperature requirements may be relaxed for elastomers in contact with these oils, it was added.

Mr. Straus explained in some detail the tests involved in evaluating O-rings for use in hydraulic fluids in aircraft and the requirements contained in a new specification MIL-P-25732, soon to be issued, and the reasons for these requirements. The tests are divided into two categories, that is, physical property tests and mechanical performance tests.

Physical property tests include specific gravity, Shore hardness, tensile strength, modulus at 100% elongation, breaking elongation, volume change, permanent set, tear resistance, temperature retraction, and corrosion and adhesion.

Mechanical performance tests include a crush test; cycling tests (1) 110° F. and —65° F., and (2) 275° F. and —65° F.; and fatigue tests.

All of these tests except the test for Shore hardness are conducted on the O-ring. There has been found to be a demonstrated variance betwen results obtained from O-rings and from dumbbell specimens cut from sheet stock.

Each test was discussed with special reference to its value and meaning in O-ring testing, and the speaker then stated in summary that a compound having the following general properties should have a better-than-even chance of meeting the specification performance requirements: (1) TR 50/10 test result of —40° F. or less after seven days in low swell oil at 160° F.; (2) ultimate elongation of 180 to 200%; (3) volume swell after seven days at 160° F. in swell oil of low about 1%; (4) volume swell after seven days at 160° F. in high swell oil of 5% or less; (5) volume swell after three days at 275° F. in low swell oil of about 8% or less; (6) original Shore hardness of 72 to 75; (7) hardness after aging three days at 275° F. in low swell oil of 68 minimum; (8) original modulus of 700 to 900 psi; (9) permanent set of 1.5% or less.

The procedure for qualification of hydraulic O-rings by WADC was also described, and a check list for the further evaluation of high temperature O-ring compounds was also offered.

"Compounds for High-Temperature Fuel Seals and Their Testing under Simulated Use Conditions," by E. J. Fujiwara and R. G. Spain, Wyandotte Chemicals Corp., described a special apparatus for testing O-rings in various fuels at temperatures up to 400° F., and the results of tests on O-rings made of various elastomers.

Viton A, Du Pont's new fluorine-containing elastomer, appeared to be of the most interest with regard to fuel resistance at high temperatures.

New, partially inorganic curing agents are being prepared in an attempt to raise the thermal resistance of vulcanizate crosslinks, the speaker declared.

"Compounds for High-Temperature Fuel Sealants," by George Gregory and Irvin Seegman, Products Research Co., discussed sealants for aircraft fuel tanks, one of the most useful of which consists of liquid polysulfide rubbers cured with soluble bichromates. Fluoronated and fluoronated-silicone polymers are being investigated as are organo-metallic polymers and inorganic phosphorous and boron polymers for this type of application.

From the application angle, work to date indicates that the most rapid progress will probably be made with the so-called groove type sealant based on Dow Corning's new fluorosilicone rubber, LS-53; while work in brush and fillet sealing for high-temperature use based on Viton A is in the exploratory stage.

"Design Criteria for Fluid Sealing," by R. J. Dunsmoor, Boeing Airplane Co., described work aimed at correlating elastomeric physical properties with fluid sealing of O-rings and similar-type seals. Testing has not progressed to the point where definite correlations appear, it was explained.

Objectives of the program are the development of new functional test procedures, establishment of material specifications with realistic physical property requirements, preparation of a comprehensive seal design handbook which will allow engineers to design a seal for any application, and the establishment of physical property limits which will serve as guides for new polymer research.

Session—II

The program on March 28 was entitled "New Elastomeric Materials—the State of the Art." Mr. Kelble presided at this session.

"Elastomers for Tomorrow's Air Weapons," by Francis G. Dean, Boeing, pointed out first that elastomers will be as important in tomorrow's air weapons as they are in today's. The same properties of elastomers now utilized will be required, however, and these materials must perform their useful functions when exposed to more severe environmental influences.

Environmental conditions expected during the present day for aircraft and missiles, during the period from 1958 to 1970, and an overlapping period from 1960 on into the future were listed. During the present day, temperatures range between —100° F. and +600° F., at altitudes to 80,000 feet with its environment of ozone and reduced pressure. While at these temperatures the elastomers are also in contact with hydrocarbon fuel, synthetic lubricants, and hydraulic fluids and for certain vehicles, special fluids such as liquid oxidizers.

For the period from 1958 to 1970 it is desirable that rubber materials be available and capable of performing their normal functions at temperatures from —400° F. to +1500° F., at altitudes to 250,000 feet in the presence of ozone, ultra-violet and cosmic radiation and reduced pressure, when in contact with special fuels, lubricants, and hydraulic fluids.

From 1960 on into the future elastomeric materials will be exposed to temperatures below —400° F. to +3000° F., at an infinite altitude in the presence of ionized gases, ultra-violet and cosmic radiation, atomic gases, and reduced pressures, when in contact with special fuels, lubricants, and coolants and when exposed to atomic radiation at these temperatures.

The capability of elastomeric materials to meet today's and tomorrow's requirements does not appear to be too good; however, a few years ago we did not have the rubber materials capable of operating successfully at 500° F. that we have now, it was said. Significant progress recently was made through private and Defense Department sponsored research in meeting some of these future requirements for elastomers. Continued effort is required *now*, however, to establish with the necessary lead time, suitable materials for tomorrow's air weapons, this speaker concluded.

"Status of Air Force Polymer Development Effort," by Maj. W. Postelnek, WADC, discussed the Air Force's current polymer program and future plans with respect to organic polymers, inorganic and semi-inorganic polymers, and future considerations.

In the field of organic polymers, copolymers of perfluoropropanes and vinylidine fluoride, fluorinated polyester rubbers, fluorinated analogs of nylon polymer, fluoroalkyl silicone polymers, and heteroatomic fluorine polymers were discussed.

In the field of inorganic polymers, mention was made of boron-phosphorus, nitrogen-phosphorus, and berylium ester systems as the most promising systems for attaining thermally stable elastomers. At present, however, there are no such polymers which can be considered as elastomeric engineering materials.

Since several new elastomeric materials have been made available which exhibit good thermal stability as well as fuel and oil resistance and which can be utilized in aircraft for the next five years or so,

increased emphasis is to be placed on new inorganic systems, it was stated. Although considerable progress has been achieved over a six-year period toward the development of thermally stable organic elastomers, it is expected that a considerably longer period will be required for the development of new systems stable to 750 to 1000° F.

"Fluoro Elastomer Development," by J. F. Abere, Minnesota Mining & Mfg. Co., was a comprehensive description of Air Force sponsored fluororubber research at 3M between 1949 and 1957. The conditioning factors which shaped the course of this program were given as follows: (1) superior flexibility at low temperatures; (2) solvent and fuel resistance in the range not possessed by any known previous elastomer; (3) later in the program, the additional qualification of excellent high temperature properties was added.

Dr. Abere first reviewed historically the development of the 3M program and discussed the materials studied. He then covered 3M's 1F4 and 2F4 fluororubbers more specifically and finally provided some comparative data on 1F4, 2F4, Du Pont's Viton, and Dow Corning's LS-53.

It was said in summary that in elastic behavior, particularly in constancy of values, LS-53 has the best properties. Preliminary data indicate that fluorine is detrimental to the best properties in silicone structure. The extreme effectiveness of the inclusion of ether oxygen in the side group was shown. The 2F4 rubber is mechanically a very promising material for many engineering design applications, particularly since it displays very good mechanical properties with extreme solvent and diester resistance plus superior high-temperature stability.

"A Versatile New Family of Elastomers," by G. E. Meyer, Goodyear Tire & Rubber Co., described these new elastomers prepared by free radical addition of aliphatic mercaptans to the double-bonds of diene polymers. High saturation levels were readily achieved without degradation of the basic polymer chain. The technology is similar to ordinary emulsion polymerization.

By varying the nature of the base polymer, the mercaptan used, and the extent of saturation, a wide range of compositions and of physical properties were attained in the adducts. In general, resistance to aging, ozone attack, heat, solvent swelling, and to permeation by gases increased with increasing extent of saturation. Outstanding performance in these qualities was achieved by adducts of polymers whose double-bonds had been more than 90% saturated.

Adducts with saturation levels up to about 85% could be cured by the same procedures used for the base polymers. Activated or "butyl type" curing systems were required for higher saturation levels.

End-use applications where these methyl mercaptan-polybutadiene adduct polymers have offered promise of doing a job as well as or better than has been possible by rubbers already in use are removable white sidewall for tires, radiator coolant hose, impregnant for airship fabric, and oil-resistant foam for railroad journal boxes. These new elastomers are also attractive candidates for replacing or supplementing presently available "specialty" rubbers in a large variety of other end-products, it was added.

The manufacture of adduct elastomers, although somewhat similar in technology and equipment to that used for making styrene-butadiene and like polymers, is sufficiently different to require substantial alterations in plant installations. The long-range prospects for manufacture of many types of this versatile new family of elastomers at prices competitive with present high-performance rubbers are considered very encouraging, however.

"Silicones and Fluorosilicones," by J. F. Dellaria, Dow Corning Corp., compared general-purpose silicone rubbers with a new fluorosilicone rubber LS-53, with regard to resistance to fuels, lubricants, and hydraulic fluids, and properties at high and low temperatures.

The chemical resistance and physical properties of fluorosilicone rubber are comparable to conventional silicone rubbers, but solvent, fuel, and oil resistance is much superior. Fluorosilicone rubber shows practically no change in hardness or swell in silicone fluids, regardless of the viscosity of the silicone fluid used. Results to date indicate that the high-temperature stability of fluorosilicone rubber approaches that of general-purpose silicone rubber. The low-temperature flexibility of LS-53 is better than that of dimethylpolysiloxane rubbers, but not so good as that of extreme temperature silicone rubbers.

"Recent Developments in Silicone Rubber for the Aircraft Industry," by J. C. Caprino, General Electric Co., was concerned primarily with a new silicone rubber compound designated 81716 said to combine the physical strength usually associated with organic rubbers with the unusual temperature resistance of silicone rubbers. The new compound will make possible airframe seals far more rugged than any now in service where a temperature range of —150 to +500° F. is encountered, it was added.

Typical aircraft industry applications include diaphragms, boots and bellows, forming blankets, seals for firewalls, bomb-bay doors, wheel and camera wells, hatches, windows, and canopies.

Depending on curing processes used in fabrication, 81716 will show physical property values in the ranges of 1500 to 1800 psi. tensile strength; 600 to 750% elongation; and 180 to 225 pounds per inch tear strength. The new compound was said to be the only one now available to fabricators of rubber components for airframes to meet AMS 3345 requirements for tensile and tear strength, elongation, dry heat resistance, compression set, and low-temperature flexibility.

Now available in limited quantities for evaluation, 81716 has been found to have excellent handling characteristics for extrusion, calendering, and molding. Supplied with or without a catalyst, it may be cured by a variety of oven, hot-air vulcanization, or steam cures.

"A Progress Report on Silicone Elastomers," by E. G. Schwarz, Union Carbide & Carbon Corp., discussed "controlled reactivity" compounds with unique curing systems, conductive compounds, preconditioned stocks, and bonding systems and concluded with a look at the future of silicone elastomers.

The "controlled reactivity" compounds consist of a vinyl containing dimethyl polysiloxane polymer cured with ditertiary butyl peroxide wherein only 25% of the amount of peroxide is required for the vinyl as compared with the methyl silicone rubbers. A tight initial cure is obtained, and the free radicals are not available for curing until a temperature of 285° F. is reached, thus permitting improved molding procedures.

The use of the ditertiary butyl peroxide or dicumyl peroxide provides means for formulating a conductive silicone rubber compound, X-1516, which retains its conductivity even though flexed. A number of HAF and HMF blacks may be used in X-1516, but acetylene blacks give superior electrical properties.

Preconditioned compounds in five hardnesses from 40 to 80 Shore durometer provide means of eliminating step-wise postcuring on thick sections and give low compression-set properties without toxic additives.

New types of silicone rubber stocks which can be both extruded and calendered in very smooth, thin sheets, and the ability of these compounds to be bonded to synthetic fabrics, such as nylon and Dacron (treated with commercially available primers) have created a new concept in hot air ducting construction, it was said.

Limited field evaluation of a new metal primer shows promise in preparing silicone rubber-to-metal bonds stable at elevated temperatures.

Future developments in silicone rubber were considered to have the best chance of success from the addition of other materials to the basic silicone polymer, and copolymers with organic materials may well provide an optimum balance of properties, it was added.

"Viton—Its Application in Air Weapons," by J. S. Rugg, E. I. du Pont de Nemours & Co., Inc., was devoted to a description of a new fluorine-containing polymer, with special reference to the heat, fluid, and chemical resistance of its vulcanizates. This new synthetic rubber has evoked considerable interest in the air weapons field since it is a possible solution to some of the difficult problems encountered in the design of advanced aircraft. Viton is now available in small quantities for laboratory evaluation and limited development purposes. Manufacturing facilities will be expanded to provide production quantities for developments growing out of the current evaluation program.

In common with other elastomers, the tensile strength and % elongation of Viton stocks are reduced progressively as the testing temperature increases. There is, however, little further reduction in properties at temperatures above 400° F. Viton stocks also have good resistance to compression set and deformation at high temperatures. An outstanding feature of

this new polymer is that the reduction of tensile strength is a reversible physical effect and is not related to deterioration of the elastomer itself.

Viton is resistant to most special fluids used in air weapons and, in addition, is resistant to aromatic and aliphatic hydrocarbons, aromatic amines, chlorinated hydrocarbons, diluted and concentrated mineral acids and alkalies, petroleum hydrocarbons and water.

Potential fields of application now being investigated include O-rings, packings, seals, fuel cells, hose, wire insulation, and caulks, coatings, and adhesives. The scope of Viton technology is limited, but growing rapidly, it was said.

"Teflon and Teflon Modifications," by C. F. Carr, Du Pont, reviewed the basic properties of Teflon resins together with some of the wide variety of applications which exemplify these properties in the aircraft industry. Some recent modifications in fabricating techniques were also described. Teflon tetrafluoroethylene resins are not elastomers but they are used in conjunction with elastomers in many applications, and they are even replacing elastomers in many other cases, this speaker declared.

High-temperature stability at 500° F. and even approaching 1000° F. for intermittent use, superior electrical properties, and the very low coefficient of friction were exceptional properties of Teflon resins stressed.

Applications for gaskets, packings and valve components, in electronic parts and for liners for rigid pipe were described.

A treatment for bonding parts made of Teflon resins has been developed, and they can now be bonded with commercial adhesives. Another fabricating development designed to improve the mechanical properties of parts made from these resins is the use of organic additives. Various compounds can be tailored to suit a wide variety of chemical, mechanical, and electrical requirements. Common additives include glass fiber, graphite, molybdenum, copper, and asbestos.

"WADC Evaluation of Experimental Polymers," by W. R. Griffin, Rubber Products Section, WADC Materials Laboratory, explained that the Rubber Products Section has as its ultimate objective the preparation of Air Force Specifications on rubber materials for use in present and future air weapons.

The complete evaluation of a new polymer is an involved process requiring compounding studies for reinforcing agents, cross-linking systems, and other additives used to impart specific properties, it was explained. Processing characteristics, fabrication techniques, and even toxicity studies enter into this evaluation as well as the obvious testing in the simulated environments of aircraft systems. The development of experimental fabrication techniques implies the extension of the present state of the art of new and perhaps entirely different materials. Without this latter development, the full potential of a polymer cannot be realized, the speaker added.

The work done under WADC contract on fluororubbers by Minnesota Mining & Mfg. Co., since 1949, which resulted in the development of 1F4 and 2F4 rubbers, was described. The 1F4 or "Poly FBA" rubber is available commercially for end-item production.

The Kel-F elastomers developed by the M. W. Kellogg Co., under Quartermaster Corps contract were next discussed. These trifluorochloroethylene-vinylidine fluoride copolymers were found to be of interest to the Air Force. Of particular interest was the resistance of Kel-F elastomers to fuming nitric acid.

The 3M and Kellogg elastomers were said to be suitable as low-temperature fuel-resistant polymers, but were somewhat limited with regard to low-temperature flexibility. By taking a good low-temperature rubber and adding fluorine to impart fuel resistance, Hooker Electrochemical Co., under Air Force contract has developed hexafluoropentamethylene adipate, which seems to have many of the combinations of properties desired.

The above-mentioned polymers and Du Pont's fluororubber, Viton A, and Dow Corning's new fluorosilicone rubber, LS-53, for resistance to high-temperature oil and hydraulic applications accompanied by exposure to nuclear radiation were evaluated in some detail.

Skin friction of supersonic aircraft will cause high temperatures to develop in fuel cell walls, and this condition will create a critical situation for the walls not cooled by liquid fuel. A fuel-cell test cube has been fabricated which shows considerable promise, not only from withstanding the effect of fuel and fuel vapor, but from permeability considerations as well. As they become available, the new, promising polymers will be fabricated into the type of end-items for which they are suited and will be evaluated for final potential as elastomers for air weapons. The real potential as an elastomer for air weapons lies in this final evaluation of actual end-items under operational conditions, it was said in conclusion.

Havenhill and Faith Speak at Tlargi Meeting

A talk entitled, "The Electrostatic Contact Potential Theory of the Reinforcement of Rubber," was given by R. S. Havenhill, head of the rubber research and electronics laboratories of St. Joseph Lead Co., Monaca, Pa., before 75 members and guests of The Los Angeles Rubber Group, Inc., at the Biltmore Hotel, Los Angeles, Calif., April 2.

After-dinner speaker was W. L. Faith, managing director of the Air Pollution Foundation, who discussed "The Automobile Problem."

Mr. Havenhill described the role of the electrical potentials in determining the breakdown of the rubber, and the proper sequence and timing of the milling operations, during Banbury mixing. Reinforcement was explained on the basis of the strong electrostatic attractive forces between the positive pigments and the negative rubber.

Electrostatic mixing charts were presented which showed that by making the electrical charge on zinc oxide more positive (by coating), its incorporation rate could be increased. The positive coating also produced improved dispersion and a 20% savings in power consumption.

By following the changes in electrical potential of the rubber during mixing, it should be possible to improve on quality through better dispersion and to reduce costs through proper sequence and timing of the mixing operations, according to the St. Joseph Lead researcher.

Dr. Faith indicated that smog originates in most cases in the vicinity of traffic arteries. Laboratory tests showed that smog is a combination of nitrogen dioxide and unburned fuel from automobile exhaust, and this condition could be reproduced in the laboratory. He said such automotive exhaust products could be minimized by the use of an after-burner. He stated his belief that some sort of controls would have to be adopted by smog-smitten communities.

Rubber Division, ACS, Abstracts Due June 21

The fall meeting of the Division of Rubber Chemistry of the American Chemical Society will be held with the parent Society in New York, N. Y., at the Commodore Hotel, September 11 through 13.

The deadline for abstracts of papers for this Rubber Division meeting is June 21. Abstracts should be about 200 words, submitted to the acting secretary of the Division, S. G. Byam, E. I. du Pont de Nemours & Co., Inc., P. O. Box 406, Wilmington, Del. In the letter of transmittal, the following information should be included: (1) the laboratory in which the work was done; (2) who will deliver the paper; and (3) how much time is required for presentation. At least one of the authors must be a member of the Society.

Goodyear's Rim Schools

A series of rim education schools are being conducted by the metal products division of The Goodyear Tire & Rubber Co., Akron, O., to familiarize tire dealers and large equipment owners throughout the United States and parts of Canada with the latest techniques in servicing large earthmover tires and rims.

Three schools are in simultaneous operation in the eastern, central, and western sections of the country. They are sponsored by local distributors and conducted by Goodyear rim engineers. The training program is centered around tubeless assemblies which are featured on new earthmover equipment.

The project has been timed to precede the recently announced federal highway appropriation of $35 billion, according to H. J. Lafaye, general manager of the metal products division.

Akron Group April Meeting on Marketing, Purchasing, Distribution, and Patents

THE Akron Rubber Group at its meeting on April 5 at the Sheraton-Mayflower Hotel, Akron, O., departed from the more or less established form of program consisting of papers and a panel discussion on technical subjects to offer a series of four papers dealing with marketing research, purchasing, distribution, and patents. The theme of the meeting was "An Introduction to the Business of Rubber."

Marketing research was discussed by John T. Cahoon, Firestone Tire & Rubber Co.; purchasing by W. R. Lantz, Sun Rubber Co.; distribution by M. N. Thomas, Goodyear Tire & Rubber Co.; and patents by V. L. Oldham, of Oldham & Oldham.

Approximately 400 members attended the afternoon meeting, despite inclement weather, and 600 attended the dinner in the evening, when the speaker was William Littlewood, vice president in charge of equipment research for American Airlines. Mr. Littlewood's subject was "Of Wings and Things." He explained in some detail the constant research for and development of improved equipment by scheduled airlines in the interest of greater safety and economical operation.

It was announced that the membership of the Group had passed 1700.

Akron Group's "Introduction to the Business of Rubber" speakers

Marketing Research in the Business of Rubber

By John T. Cahoon

Firestone Tire & Rubber Co., Akron, O.

I HAVE only a short time this afternoon to outline for you a tremendously important function for a rubber company, that is, marketing research. I will only be able to tell you about a few of the projects our department handles for Firestone and merely mention other kinds of work we are called on to do.

Our job is to help executives make decisions.

It has been claimed that executive ability is the art of getting credit for all the work somebody else does. That isn't true. An executive's ability is measured by the contribution he makes to the decision-making process in a corporation. The executive contributes to the making of the important decisions, and it is usually only on the important decisions that he calls on a marketing research department for help.

Whether or not a rubber company has a marketing research man, it still has a group of important decisions to make about its product and marketing mix.

By this I mean that it has to answer such questions as: What product will we make? Shall we specialize on one product, or try to produce several? How many of each item will we produce? How will the production break down by size and type? If we produce a new item, how many can we sell? How much will it cost to make, and what price can we sell it for? If we bring out a low-cost line to sell at a cheaper price, will it hurt the sales of our regular line?

Another important group of questions that must be answered concerns the marketing mix. Will the company sell to wholesalers, direct to retailers, or direct to the company or family that is going to use the product? Will the sales effort rely on salesmen, on direct mail and catalogs, or a combination? Will the company offer lots of service and advice to its customers, or will it stress low price and easy availability through a large number of outlets? Should the advertising campaign be increased, or not? Is advertising of more use in general consumer magazines or in trade papers?

Our job is to help management answer these questions and make these decisions.

Market Research Reports

If the problem warrants it, management can ask for a research report pulling together all the facts, analyzing them, and organizing them to show which decision ought to be made in the best judgment of the researcher. The executive may not agree with the analysis, and he may decide not to follow the recommendation. But because the facts were gathered and organized for him, he still is able to make his decision more quickly and on more solid grounds.

The American Marketing Association, the professional association devoted "to the advancement of science in marketing," defines marketing research this way: "the gathering, recording, and analysis of all facts about problems related to the transfer and sale of goods and services from producer to consumer."

Obviously, it is a help just to have someone available who can be asked to dig up and organize the facts. It is even more of a help to have someone who is continuously working on similar problems, because such a researcher develops a stockpile of information from inside and outside the company which would not ordinarily be available and can be used on short notice.

Techniques

The professional marketing researcher also has some special skills which make his function a little more valuable than merely "digging up" and "stockpiling."

Typically, the marketing researcher believes in a systematic and a quantitative study of a problem. He lists all the factors he can think of that bear on his assignment; then he goes out looking for more that he may have overlooked. He runs them all down, and he tries to get a quantitative expression of his results. He isn't satisfied with the answer that a product is a lot better—he wants to know how many percentage points better it is. He isn't satisfied if an item will be profitable—he wants to know the dollar and percentage profit that it will produce.

He also has some gadgets. Because he tries to pin his findings down in figures, he is able to use some of the tools of statistics and higher mathematics. One of his very important tools is the sampling technique, by which he is able to make dependable statements by studying only a small, carefully chosen sample group. This may be a group of people, like customers, employes, dealers, and so on, or a sample may be designed to represent the entire product line, an entire geographic area, an entire working day for a salesman, or whatever is desired.

Particularly in consumer research, the marketing man also uses tools developed by psychologists to find out why and how people buy.

Sales Forecasting

At Firestone, one of the few assignments we handle on a regular basis is the important one of sales forecasting. Andrew Carnegie was once asked which is most important—labor, capital, or brains. His answer was, "Which is the most important leg of a three-legged stool?" Mr. Carnegie, the personnel people, the financial men, and the product development people might argue with me, but my feeling is that *demand* supports the stool; thus it is the great determinant of business activity.

To forecast sales, we get together every bit of information that will bear on *demand*. We look for answers as to whether the customers will have buying power to back up their demand, as to whether business and consumer confidence is adequate to cause customers to want to use their power to buy. We find out what prices are likely to be and ask ourselves whether they are or are not so high as to discourage buying. Last, we find out whether the supply of product will be available to satisfy the demand.

Often we can find out something about related factors in the economy which will affect our sales. Predicting the number of cars in use which are 2½ years old or older improves considerably our forecast of sales of passenger tires for replacements. Predicting the formation of new households and the number of old cars scrapped helps us to predict the sales of new automobiles. It doesn't help us enough, however, and new automobiles present one of our hardest prediction problems. Also we have one pretty dependable formula in predicting, that is, every new car—well almost every new car—will carry five tires as original equipment.

Naturally, we make sales forecasts only for the major products. We make on a regular basis these sales estimates: (1) tires; (2) tubes; (3) retreads; (4) camelback; (5) batteries; (6) television; (7) major appliances; (8) foam rubber products.

On an irregular basis, we make short- and long-range forecasts of many other products. It is a necessary part of our forecasting to predict the economic picture of the country, and this forecast is also presented to our management.

Our bread-and-butter forecast is a short-range one of tire sales. This forecast is made at three-month intervals and covers the succeeding 12 months. We also make a semi-long-range estimate of the next fiscal year six months before it begins, and we make really long-range forecasts for periods of five or more years ahead.

Other Forecasts

Obviously, the main use of the very-long-range forecast is for overall company planning—for decisions on adding capacity and building plants, for example.

The short-range forecast, however, is for immediate use by a variety of departments. Among them are manufacturer's sales, trade sales, export, budget, tire distribution, and production planning. Obviously, the inventory required can be calculated from the forecast, and the production of the required tires can be planned to make best use of the work force and manufacturing capacity. The forecast permits the sales departments to set their quotas and plan their manpower requirements.

One of the most important uses of the forecast for any company is in the preparation of a sales budget. I mean the complete statement which shows the sales the company expects to get in the ensuing period, the cost of goods sold, the expense of distribution, and the profit. In other words, a profit and loss statement on the sales department. Every company should have one.

To meet the needs of all these departments, the forecasting process has to go something like this. First comes the overall forecast of the economy; next the forecast of factors directly related to important segments of the tire market; then the estimate of the total number of tires that will be sold for replacement, for original equipment, for export, and for military use.

Each of these estimates is broken down by passenger tires (in turn broken down into black and white-black sidewalls), truck-bus tires (in turn broken down into seven size groups), large and small tractor-implement tires, and airplane tires.

Each estimate is broken down into forecasts of sales for individual months.

With the industry picture laid out, all of this is gone through for Firestone on the basis of what our sales and development people are planning, and Firestone's share or percentage of industry sales for each segment is developed.

Such a forecasting process is widely used in American business. Most of the large corporations prepare a forecast of the economy, specifically the gross national product, meaning the dollar total of all goods and services produced in the country. You can buy a good forecast from a business advisory service, but if you are developing your own, the best method is to start by estimating separately the demand for each type of goods or service and build up to an overall total.

We know that most business forecasters have a special knowledge of factors affecting their own industry, and several months ago we developed an estimate of gross national product for 1957 by a means never tried before, so far as we know. We wrote to more than 1,100 companies inquiring, in each case, how the total sales of their particular industry for 1956 and for 1957 would compare with sales in 1955.

More than half the companies had industry forecasts and were able to give them to us. They enabled us, item by item, to see the probable change in consumer spending, in spending for new construction, and in spending for producers' durable equipment. Coupled with our own estimate of probable spending by the government, the picture added up to a 1957 gross national product of $432 billion, a 5% increase over the 1956 figure.

I hope our respondents are right—and that we have developed an economic forecasting technique that will be of value in the future—however, it's still a little early to tell how the year will turn out—right now business activity is off a little.

Market Research Projects

Suppose now that the company is considering a new product and that marketing research is assigned to make a study of the subject. Essentially what we have to do is to estimate demand for the product. Who will buy it, and will they pay enough to cover costs and make the venture attractive? How many can the industry sell? From what we know of the market and about competitors, how many units can Firestone expect to sell? We have to forecast sales and estimate a budget for the product.

In the case of a new product, such as air springs for automobiles, we already know the automobile market thoroughly. Information on the cost and the performance of the present type of springs is easily available. Whether autos carry air springs or steel springs is not going to change the total sales of autos; so we know, or think we know, the size of the potential market from our regular forecasting.

A harder problem was posed some years ago when Firestone was offered the manufacturing rights on a device to be used in air-brake systems. We had to find some quick answers as to whether there was a real need of the device, who would buy how many, and at what price.

What we did was to pull together a complete picture of the air-brake industry. In a quick trip we talked over the possibilities of the device with more than 20 key companies in the truck, bus, and air-brake fields. It was quickly apparent that there was a sizable market at a favorable price for a device which would eliminate some of the major problems with air-brake systems. Almost all busses

and all the larger trucks could use the device, and most of these vehicles are owned in fleets.

It was also apparent that the device must do what was claimed for it and be almost completely trouble-free if it were to be accepted. The approval of the major trade associations of fleet owners and of the major manufacturers of air brakes was essential. If their requirements could be met, fleet owners would eagerly test the device on their units and buy substantially if their experience was favorable.

At this point, the device was turned over to Firestone engineers for tests and an estimate of whether the device could meet the requirements set for it. Negotiations with the holder of the patent would follow if the engineering report was encouraging.

Now let me illustrate a very different type of marketing research problem—that of setting consumer prices. The tire market, as you know, is plagued by weakness of the price structure. You know what I mean by that. You may have heard of the sign that read, "For Rent, $50; at the very least, $40." All too much of the time that is the way it has been in the tire business, and the tire dealers have had to add lines of associated products on which the price structure is firmer. It became evident to Firestone that the dealers lacked skill in setting prices for these home and auto supply products which would be competitive so that sales would not be lost, but which at the same time would return the dealer the normal gross profit on each item.

You know how department stores solve this problem—by using comparative shoppers who go out and buy merchandise from competitors. The average tire dealer is not skilled enough and not big enough to use such a method for all of the hundreds of home and auto supply items he handles.

The solution worked out by our marketing research department in this case involved training comparison shoppers who became fairly expert on certain types of home and auto supplies. Through knowledge of the small number of products they were shopping, these men were able to make a comparison of the worth of an item offered by a competitor in terms of its relation to the value of the Firestone item. Only with this ability to estimate product quality and the importance of product features could we make a fair comparison of the prices being charged by Firestone and by competitors.

Using more than one shopper on each product group, and getting comparative prices throughout the nation, we discovered that some of our home and auto supplies were priced too high. We brought the prices down and scored substantial sales increases on most of these. But the vast majority of the retail prices were too low in relation to competitive offerings. We raised these prices and received no report that sales losses resulted anywhere along the line on the items. The techniques developed to solve this problem, incidentally, won a national award from the American Marketing Association for their creator, T. G. MacGowan, at the time manager of Firestone's marketing research department, as a "substantial contribution to the advancement of science in marketing."

In another study, we checked to see how aggressive our outlets and the outlets of the other rubber companies were. Among the things we did was to drive in for gasoline in a car with the right front tire smooth and badly under-inflated. In 107 service stations tried with this approach, not one attendant stooped down to look at the tires or asked if he might check their air pressure. The investigators then *asked* to have the tires checked, but only a fifth of the attendants mentioned the one very soft tire and only 5% of them even mentioned the fact that one tire was entirely smooth!

Here we certainly have an outstanding case of losing a good chance to sell a tire, and the picture was just as bad on missing obvious chances to sell batteries, wiper-blades, etc.

This picture is confirmed by consumer research. A recent Du Pont study came up with the following: Only about one car owner in three buys a new tire during a year. Of the people who do buy a tire, less than one in five remembers anyone suggesting to him that he needed tires. The average customer decides that he needs tires because his present ones look smooth or worn. He usually buys new tires as opposed to retreads and usually from the first tire outlet where he prices tires. Typically, he buys two or three tires at the same time.

This sort of research shows the opportunity for aggressive retail outlets to build up their tire sales. At the same time, the research is of great value in guiding advertising.

An especially valuable research area is one that leads to reduction in the cost of distribution. One of our projects in this area involved traveling right along with our wholesale salesmen to find out how they actually put in their time in urban and rural areas. We analyzed the amount of travel time, idle time, time spent taking inventory, time writing reports, and so on. An especially valuable analysis was the amount of time spent calling on dealers of various sizes. We have done other work on the cost and profit of selling through small outlets. Since the cost of distribution is under constant pressure, we have had to develop ways to service small outlets adequately without making them uneconomical for Firestone.

Broad-Scope Projects

I have mentioned only a few of the kinds of problems that our department works on for management, and I think you can see how the systematic, quantitative approach gives us a means of attacking a problem.

A dividend from this sort of research is provided in the form of marketing control. There are bound to be differences in sales performance between different sales districts or between different product lines from one year to the next. Management is sure to be told by those responsible that the low sales performance was due to special situations, to depressed economic conditions for a particular area or product, for example.

Management knows, however, that some of the difference is due to the ability or the strategy of the particular men involved. Perhaps our product and merchandising policies were wrong; the policies may have been wrongly applied; or they may have failed to adapt to changing conditions.

Marketing research can offer data to check the claim that economic conditions were the primary cause of poor performance. It can usually pin down the particular sales which lagged and isolate the major reasons for the situation.

I would be less than frank if I did not mention that our department handles a great many business and management assignments not primarily concerned with marketing. Our kind of study, and the kind of man that we keep on tap in our department, can be valuable with other kinds of management problems. Just to give you an idea, we have worked on organization studies, personnel practices, plant location, production capacity, inventory control, warehousing, credit, etc.

I have covered some of our marketing research work in a rather sketchy way. But I hope I have made clear that essentially we help in the decision making and in the planning—functions which have to be performed whether you have a marketing researcher available or not.

Our work is taken and carried forward by purchasing and by tire distribution, among other departments, and the speakers to follow will show how those vital functions operate.

Purchasing As a Management Function

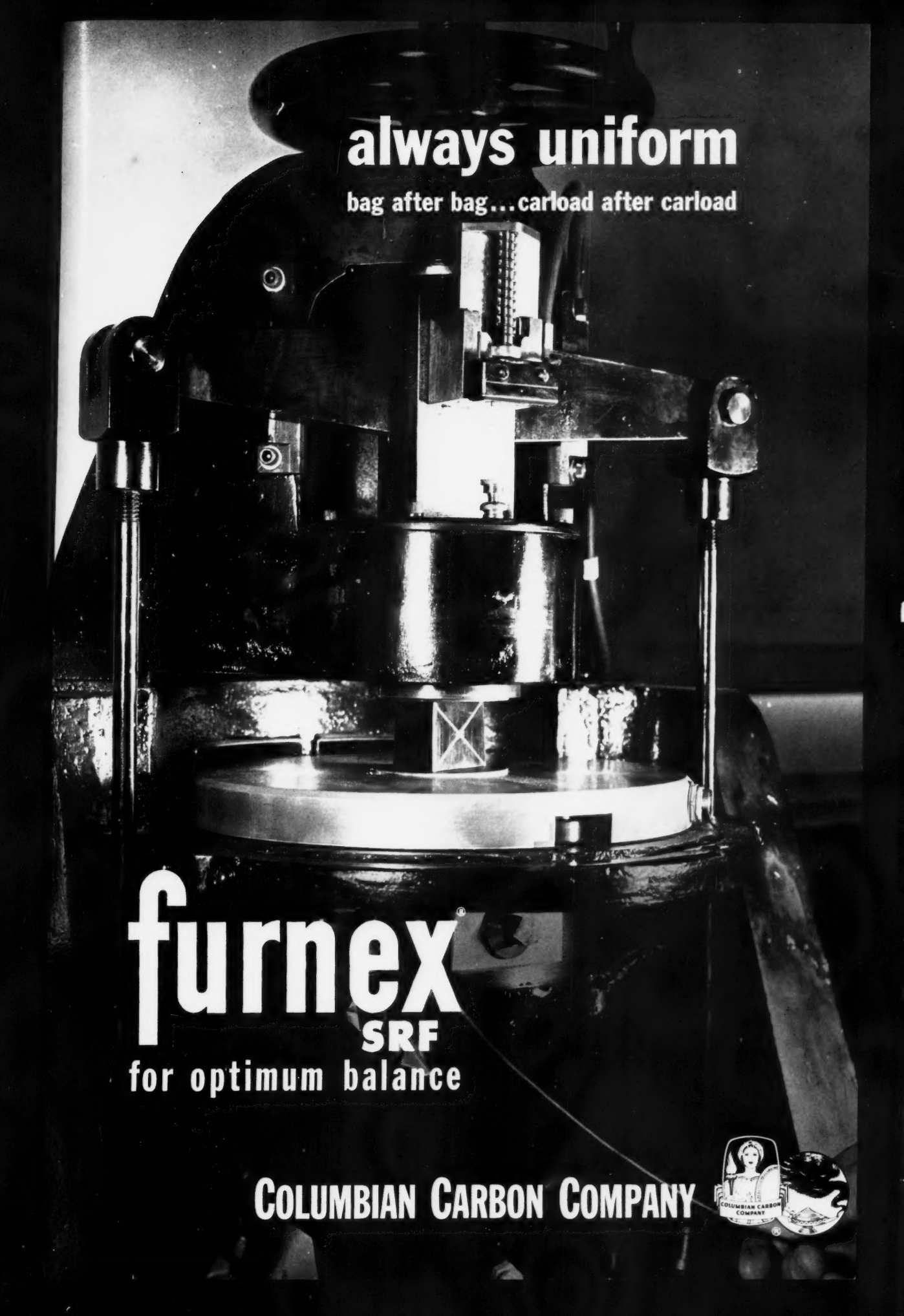
By W. R. Lantz

Sun Rubber Co., Barberton, O.

PREPARATORY to examining purchasing as a management function, let me remind you that industrial buying covers a very broad area of our industrial and economic life. While it is almost certainly true that sales are the cornerstone of our economy, it is also true that purchasing is of equal importance—every sale must have as its counterpart, a purchase.

Recent manufacturing cost data prepared from the United States Department of Commerce reports indicate that more than 54% of the value of manufactured goods derives from purchased materials or services. Thus it is abundantly clear that wisely planned and closely controlled procurement and utilization of materials are essential to the maintenance and ofttimes the creation of profit. Since we are, all of us, a part of, or closely associated with, manufacturing, let us first treat of that particular phase of our subject.

Webster defines the word manufacture thus: "To work as raw or partly wrought material into suitable form for use." Be-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between the determination of the need of this raw or partly wrought material and "suitable form" there must occur a series of integrated and closely related steps—all necessary to bringing about the end-result for which the business exists.

Modern Business Policies

Over the past decade and at an accelerated rate in the past three or four years, a number of management views and policies have developed which focus attention on the importance of these steps. They are:

(1) The growing recognition of the interdependence of development and design, manufacturing, finance, and supply.

(2) The need of pooled judgment in the administration and the execution of policy.

(3) Increasing recognition of the need of better, more accurate inventory control.

(4) The development of so-called materials management—from acquisition to disposition.

(5) The growing need of adequately trained, professionally qualified personnel.

Now! What are the steps and usual order of their occurrence?

First—There must be established a specification for, or a definition of, the particular end-product. So, sales of market research, or some similar function must describe the product based on consumer demand, style, service life, price, competition, etc. Then must come an estimate or forecast of how much can be sold and when the product must be ready for market.

Second—Engineering and manufacturing specifications must be developed and fixed—usually by product design or engineering coordinate with manufacturing techniques, facilities, capacity, equipment, manpower, and supervisory skills.

Third—Processes, methods, materials, specifications must be set up and reviewed frequently by all interested and contributing functions to insure attainment and, wherever possible, the betterment of previously calculated costs and related operating budgets.

Fourth—The scheduling of production, the transportation, storage, and flow of raw materials, the supply of labor, all must be brought under close control and supervision, and this close control and supervision must be maintained to utilize both materials and labor effectively.

Fifth—The acquisition of materials must be arranged for in an ever-changing market to insure delivery at the right time, of the right quality in the right quantity and at the right place, at the right price.

Purchasing Policy

Each manufacturing enterprise must therefore develop and employ, under qualified personnel, a purchasing policy capable of meeting the exacting requirements of its manufacturing, sales, and changing market place.

To do this requires continuous attention to and evaluation of all the factors affecting supply, inventory, cost and supplier good will

Many purchasing departments operate as a part of their function or in collaboration with other departments a purchase analysis system which seeks with respect to each item to be bought: (1) elimination of the item; (2) simplification of design directed to lowering cost of manufacture; (3) review of raw materials directed to use of cheaper or more readily available substitutes; (4) review of methods of manufacture for purpose of insuring use of most economic method; (5) effort to conform, if possible, to industry or other standards, thus increasing possible sources and reducing cost; (6) continuously develop and work to maintain several satisfactory and dependable sources for each item bought.

Effective inventory control and sound purchasing policy must take into account such diverse factors as: (1) amount on hand and in transit; (2) when and over what period of time will material be used; (3) cost of storage; (4) obsolescence and perishability; (5) cost of handling; (6) investment cost; (7) cost of buying; (8) quantity discounts; (9) market conditions and price trends; (10) time required for delivery.

Now, while inventory control, inventory policy, and procurement policy are high sounding titles likely to bring to mind the picture of a dignified, mahogany paneled board room, furnished in simple and stately elegance and housing the "operating committee" or the "executive committee" whence issues far-reaching and carefully arrived at decisions, the truth is that their execution at the operating level is a matter of daily and ofttimes tiresome attention to small and seemingly unimportant details. It is a constant duty of the purchasing function to act promptly on each purchase request devoting only such time and effort to the fulfillment of each as is justified on cost or economic grounds. To put it bluntly, it is often more important to obtain an item of small value *now* than to be concerned at all about whether it was bought at the lowest price.

In contrast, however, on many occasions engineering, manufacturing, and other departments insist on taking all the time they feel they require to perform their duties, then insist that a large contract or order be placed with the first source consulted because "time is of the essence." With the latter I must disagree. If it is worth doing and involves any large expenditure, than it *must* be done well.

All purchases, large or small, involve in some degree, decisions with respect to the following considerations: (1) selection of one or more than one source; (2) qualification of each potential supplier; (3) transportation costs; (4) discounts and terms of payment.

Where materials to be bought are essential to production, then sound policy dictates the development and the use of more than one source of supply wherever possible. Strikes, floods, and similar interruptions to the orderly flow of materials are avoided or in large part minimized where several sources are available.

Purchase Contracts

The negotiation of contracts involves considerations not only by the type and kinds of materials or services involved, and therefore the type of contract to be let, but the price policies of the several suppliers and the conditions existing and likely to exist in the market. Obviously, the firm which adheres to a sound and uniform price policy finds it easier to sell on long-term contracts than one whose policy varies with each customer and whose prices are not firm from month to month.

In certain markets and within certain trade associations, standard contracts prevail under which the terms are standard for all classes of trade. Examples are found in contracts for crude rubber, Worth Street sales notes involving the purchase and sale of cotton textiles, and contracts for the construction of buildings and installation of facilities. It is of prime importance in the negotiation of any purchase that the type of contract and the terms contained therein be suited to the particular type of product or service under consideration.

In an effort to streamline and simplify the contract form or purchase order form itself, most companies have devised, with the aid of legal counsel, standard terms and conditions which cover most of the important points of law and the intent of the contracting parties. Yet, because of the wide variety of day-to-day transactions, many special clauses and conditions have to be agreed upon and made a part of each purchase order.

I wonder how many of you present know that the practical enforcement of such federal statutes as the Robinson Patman Act, the Wages and Hours Act, and the Walsh Healy Act, to name only a few, devolves upon the buyer as well as the seller and imposes upon the buyer responsibilities for compliance therewith to the same degree as the seller who is usually considered solely responsible for compliance. Do you know, for example, what your own legal rights and responsibilities are on behalf of your own company? Do you have the authority you think you may have, and, similarly, are there responsibilities and liabilities that fall upon you of which you are not aware?

Most of these questions are those with which the experienced buyer deals every day and to which a ready answer should be his if he is to carry out his responsibilities adequately for his principals and with proper safety to himself. I can assure you that there are a number of conditions under which a commitment made by a buyer, even with the consent, or at the insistence of his principal, can result in personal obligation for himself.

Transportation Costs

An increasingly important element of cost and one which is frequently overlooked or disregarded by those not directly responsible for purchasing is that of transportation. Without attempting to appraise the causes or justification for such increases in transportation costs, it is none the less true that they comprise a far greater percentage of landed cost today than ever before and, as such, are deserving of the fullest attention by the buyer.

I have had occasion recently to investigate closely the rates which apply via rail, truck, and even air freight and air

express to the several commodities which our company uses. I was very much surprised to learn of the complexity of transportation rate structures today and the variety of interpretations placed upon the descriptive classifications of all types of merchandise. Simply to keep abreast of constantly changing rates and their effect on landed costs demands much of the buyer's time. This is true even though he may have access to a well-staffed, fully qualified traffic department or counsel.

Purchasing Scope Broad

The selection of sources of supply along with the development of new sources and even under some circumstances, the modification or change in the method of manufacture is particularly a problem and responsibility of purchasing. Why? Because the many factors which must be taken into consideration in assessing the reliability as well as the many special qualifications of the supplier are the legal responsibility of purchasing. Aside from the legal considerations involved, attention must be given to geographical location, cost of transportation, sales policy of the company, reciprocity, terms of payment, cash discounts, supplier reputation for quality, service, and follow through.

The supplier's capacity to manufacture and deliver the volume required, his financial condition, and his own buying policy all contribute to determining his desirabilty and trustworthiness as a supplier.

Certainly, ours is an age of specialization, of mechanical engineers, electrical engineers, electronics engineers, physicists, chemists, chemical engineers, metallurgists, and other scientifically trained individuals. The PhD is commonplace in industry today. Yet of all the specialists and functions we have named, none, outside of sales, has so many and such frequent contacts with the public and the outside business world as those of the purchasing department and its personnel. By their conduct and by their application of company policy, they help in a large measure to make the company's reputation; indeed, they are its personality, and to the people who call at their door, they are the company.

Certainly, then, any phase of operations which requires of the individual such a breadth of knowledge and experience and the full understanding of the problems and requirements of the operating divisions is deserving of the best qualified personnel that can be had. The protection of the investment in good will through advertising and public relations is as much a responsibility of the purchasing department as it is of sales, or management, or any other part of the business organization.

With all of its many responsibilities, the purchasing department is and must remain a service department to manufacturing and to all of the many other departments or divisions of the company who have occasion to require their assistance—all this despite the direct-line responsibility to top management. There is just one reason for the existence of any specialized function of the business enterprise, be it sales, engineering, manufacturing, finance, or development: it is its peculiar fitness and ability to contribute to the ultimate objective of making products or services for sale at a profit.

The present rate of taxation points up the increasing difficulties of maintaining profit margins in the face of ever-increasing costs. Fortunate indeed is that manufacturer who can gross 10% of net sales before taxes. This being true, the profit-making potential of purchasing is best illustrated in the example of a $5,000 savings on purchases being the equivalent of $100,000 in sales. In the same way, an error in purchasing judgment costing $5,000 means that $100,000 of sales must be made to overcome the effects of such an error.

Your purchasing department is a research organization; the eyes and ears of management insofar as market conditions and movements are concerned; it is a buffer between you and the salesman and, as we mentioned before, it is the company. Use it—that's why it exists.

Distribution

By M. N. Thomas

Goodyear Tire & Rubber Co., Akron, O.

DISTRIBUTION of goods is a broad subject which reaches from the manufacturing of finished products to the ultimate consumer. It is part of manufacturing when you consider distribution of raw material and finished components for assembly of consumer goods. It is a basic part of marketing and retailing in making goods available for consumer needs.

Yes, it's difficult to define just where distribution starts, but it usually ends with delivery to the final consumer, either for his personal consumption or, in case of industrial machinery and equipment, for use in production of consumer goods.

Can you be surprised, then, that you constantly hear of high distribution costs as compared to materials and fabrications costs?

You have heard many times that while great strides have been made in reduction of manufacturing costs through automation and research development in manufacturing techniques, distribution costs have remained high.

I subscribe to this statement insofar as it indicates that much development is ahead of us in distribution, but I cannot agree that development has been fully lacking in distribution methods.

To concentrate on one very important phase of distribution I would like to discuss it from the standpoint of the manufacturer, such as the large rubber companies, to the retail outlet without going into retail operations.

Rubber Products Distribution

First, I want to say that a large rubber company manufacturing a full line of rubber and chemical products uses practically all known distribution channels with the possible exception of the Fuller Brush house-to-house canvass; and if it required that to sell tires, you couldn't count it out.

For example, these companies use the distribution channels of—

(1) Direct to other manufacturers for component parts of automobiles, trucks, tractors, bicycles, earthmovers, airplanes, household appliances, industrial machinery, shoes, furniture and many others, even including ladies' garments.

(2) Jobbers and mass distributors on industrial production, flooring, printers' supplies and many other lines.

(3) Fabricators of products reworked from finished films and latex forms.

(4) Independent dealers, oil stations, and company-owned stores.

(5) Direct to large industrial users on such products as tank lining, steel and glass mill rollers, and many major installations in industrial machinery, also for raw materials of rubbers and resins.

(6) Contractors and building trades in flooring, conveyor belt installations, and even asphalt paving.

(7) The ever-growing and, in many lines the most important distribution channel, supplying the government.

Department Interdependence

A manufacturer cannot make a diversified line of products, many of which have thousands of variations in size, types, and styles and distribute them through so many channels without considering the direct independence between distribution, production scheduling, raw material procurement, and sales forecasting.

In our company the division handling these functions receives constant guidance and consultation from business research, sales, purchasing, and production, including the plant methods division, but crosses all lines within the company and is responsible for (1) raw material inventories and commitments; (2) plant capacities and plant schedules; (3) finished goods inventory levels and locations; (4) traffic operations; (5) warehouse distribution centers; (6) service to all customers.

Plant and Warehouse Location

This brings me to the point where I should attempt to answer the two specific items which your committee stated would be of special interest to you. These were labeled A and B.

"A"—Where would you locate plants and warehouses?

Let's take these separately as the warehouse locations would depend on not only plant locations, but your product schedule pattern within the plants.

I am going to consider here the type of operation of the large rubber companies with multiple plants.

There are five basic points to consider in plant location:

(1) *Markets* — Since finished goods transportation costs are higher than on raw materials and usually faster delivery time is required.

(2) *Natural resource requirements*, such as water and power, since they affect manufacturing costs.

(3) *Labor* — Availability, rates, living conditions, type of organization.

(4) *Raw material* — Importance varies greatly.

(5) *Transportation* — Transportation is not necessarily last in importance, but at times it can be set up to fit your needs.

The effect of markets on your location depends somewhat on whether the plant is to make a special product for specific use or a general product which you will manufacture in several plants.

For example, passenger and truck tires would be manufactured in all parts of the country; while tractor tires could be made primarily in two areas and be within less than a 100-mile radius of 90% of the manufacturers' market.

With nearly 1,000 items of truck tires in each major company's line, however, you can't manufacture all sizes and types in one plant, or your change time would eat up your capacities and give you an untenable position in production efficiency and costs.

This factor gives you the key to warehouse location. If your complete manufacture of a special product were made in one plant, and you properly considered markets and transportation in your plant location, then your major warehouse should be in your plant, which would give you the maximum availability and best possibilities of lower handling and transportation costs.

The example given on truck tires, however, which is true to a slightly less degree on passenger tires, requires that you manufacture only part of your line in each plant, then establish "mixing stocks" for complete line availability at strategically located distribution centers.

Such a warehouse location at a plant would require regularly shipping a large tonnage of finished production into what is usually a congested manufacturing area and competing with raw materials movement and goods manufactured there for use of available transportation facilities.

In this type of operation, distribution becomes a more separate function from production despite their interdependence.

Inventories

The next point your committee asked me to discuss is labeled by them as B—but if the first point was "A," then this one is probably B to Z, since it covers production plans, inventories, build-up, % time in backlog positions, total delivered costs, service-delivery time, utilization of plant capacity.

PRODUCTION PLANS. First, these plans must meet your customers' requirements; but you cannot fluctuate production schedules with changes in demands.

Basically, you must first plan your needs by market analysis, and this planning is done by forecasting sales. Forecasting starts with proper basic data and sufficient contacts in each market you serve to recognize changes and know how to interpret data made available.

Of even greater importance, however, is the frequency with which you take soundings on your forecast. No factor in business planning deteriorates faster than a forecast, and every time you turn your head the other way you have missed something.

INVENTORIES. Why do we carry them? Basically, to serve our customers; but a proper inventory must also—

(1) Level out production schedules to avoid drastic changes in total operations. This factor is more important with present-day unemployment benefits, guaranteed annual wage, longer vacations, more holidays, and other fringe items in your costs.

(2) Reduce machine and mold changes at size and type level to permit economic runs, also to provide proper balance of equipment for each production operation.

(3) Hedge capacity shortages by building ahead of peak sales periods.

(4) Provide safeguards to original-equipment accounts where you have contractural obligations to furnish components to meet their ever-changing assembly-line requirement.

(5) To get proper turn of your invested dollars commensurate with effect on production costs.

By having close coordination between raw materials and finished goods inventories there are many times when investment can be held lower on one, if the other is high, and avoid peak superimposed on peak.

% OF TIME IN BACKLOG POSITION. Backlog is something we all want as it usually means business is good. When we get it, however, we want to get rid of it in the quickest possible time. The steel companies can operate with a backlog all the time. In the rubber business, I would guess that if you are in a backlog over 10% of the time on one product, you will probably lose business, and at 20% of the time you would probably lose customers.

TOTAL DELIVERED COSTS. Too many times transportation costs are considered alone—or only warehousing and handling costs. Even these combined do not give the total delivered cost where you have more than one plant producing the same general product. In such cases individual items of size, type, and style might give you sufficiently lower production costs to absorb extra warehouse handling and transportation. Total delivered costs, then, must include transportation, warehouse handling, and production costs.

SERVICE-DELIVERY TIME. This requirement of the distribution function has the greatest challenge as you must constantly try to improve it. If you should ever be fully satisfied with what is accomplished, you will very quickly find your results are inadequate.

To create and continue a regular market for your goods you must satisfy the customer on three basic points: (1) quality—which includes style and performance; (2) price; (3) service.

You may feel sure that your quality is best, but you may have a problem to convince the customer.

The price becomes a factual calculation after quality is established, and presumably you must be competitive.

Service and delivery time is often the prime factor in getting the business, and unless your distribution function is fully adequate, effort spent on quality or profits sacrificed in price may fail to get results.

Service and delivery time means availability of goods in anticipation of sale, located in the proper place at the right time. It also means fast processing of the order by use of wire communications, accurate and fully up-to-the-minute records of stock and stock movement and fast transportation. It also means keeping your customer fully informed to preclude the necessity of his checking you. In short, it means making it easy for him to do business with you.

UTILIZATION OF PLANT CAPACITY. There is a level of production *versus* capacity at which each manufacturing plant is the most efficient and obtains the best costs. Primarily, this is at the point where overhead expenses are most fully absorbed by volume of output.

This should be the target, and, if it is definitely established, deviations from this point can be quickly calculated. This target would usually not include overtime costs for your work force; but if additional business forces overtime, this extra cost may not entirely come out of profit as the extra output may absorb overheads both in production and sales costs.

When business drops suddenly, you may be faced with reductions below this target. The increased overheads can then be calculated against the risk and the cost of additional inventory.

Increases or decreases in utilization level against plant capacity, therefore should be figured from the same basic point, and variation may be made in either daily rates of production or days per week scheduled, depending on whether the variation is temporary or for a sustained period.

Patents and Patent Law

By V. L. Oldham

Oldham & Oldham, Akron, O.

I HAVE been asked to discuss the broad subject of patents. Necessarily, I will be able only to touch briefly upon some phases of patent law, but hope that in doing so I will clarify some of your concepts about patents and patent law.

What Is Patentable?

The question, "What is patentable?," is frequently put to patent attorneys. It is difficult to give any simple answer to this apparently simple question, but one immediate answer that can be given to it is that found in United States Code, Title 35, Section 101. In such Section, it is stated that:

"Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor."

It is important that the word "invents" may be understood in the manner that is used in this definition. In general, a man is considered by law to "invent" something when he makes a development or improvement in past processes, apparatus, compositions, etc. and has gone beyond the normal skill of a man versed in such art to which the invention relates.

At one time appreciable emphasis was placed upon the doctrine that a "flash of genius," as set up in the Supreme Court case of Cuno Engineering Corp. *vs.* Automatic Devices, 62 Supreme Court 37, was required to make an invention. The patent code passed into law in July, 1952, however, effectively dispels that "genius" requirement for invention in Section 103 of Title 35, which code section provides that

patentability shall not be negatived by the manner in which an invention is made. There were some cases before such code section was passed holding that one could not patent a development, for example, made by a team of expert scientists working in a research laboratory and/or wherein the development was the gradual accumulation of knowledge by making a series of experiments in a chosen field.

Some developments are not patentable, and, for example, a law of nature, or a scientific principle, may not be patented. Furthermore, the function, result, or effect of a machine is not patentable, nor are abstract ideas, mental theories, or business systems.

Why Patent?

Another question that frequently arises commercially is that of what is the actual value of patenting a development? The obvious and first answer to this question is, to me, that it prevents any competitor or other person from duplicating your patented process, machine, article of manufacture, or composition of matter. Another value or benefit secured by patenting a development is that such patent may be of sufficiently broad scope as to prevent any competitor from coming even close to a given development covered by an issued patent. Some examples of such types of patents in the rubber industry would be the very valuable patents issued in the 1930's on rubber accelerators.

Patents frequently are valuable trading property, and rights under other persons' developments can be secured by exchanging patented developments between two parties or companies. Thus, for example, one company licenses foam-rubber making patents to another company for return rights on special rims or tires developed by the second company.

An obvious value to patents is that they may well be a source of royalty income. It should be noted that Public Law 629 of the 84th Congress provided that monies received by either licensing or sale of a patent right are to be considered long-term capital gains. Before the passage of such law, some patent income had been held to be ordinary income.

It should be understood that any issued patent, or even a pending patent application, may have a value anywhere from nothing up to thousands of dollars or more, depending on the breadth of invention covered by the development and the true novelty thereof. The value of a patent is also measured somewhat by the aggressiveness of its owner in going out and effectively licensing a certain patent right, or in making and/or selling the composition or article covered thereby.

Technical Personnel—Records

One of the first items of concern in experimental work is that of the maintenance of records of such work. In most large companies, rather stringent rules are set up regarding record keeping concerning experimental work done by technical personnel. Such a program reaps many benefits and certainly is to be recommended for each and every research worker. Thus, to know what experimental work has been done in the past, as well as to know the results thereof, it is necessary that technical personnel maintain adequate records of any and all experimental work and observations concerning the results thereof.

From a legal and patent viewpoint, the maintenance of proper and complete records by personnel on experimental work assumes particular importance. Suppose that a certain research program results in a patentable development, then it may well be that the date of the initial conception on the idea on which a patent later was being sought would be of great importance. Also, the continuing history of such idea and the diligence with which it is pursued experimentally to a successful finished experiment, or development on which a patent is sought, may be quite important in determining ownership of the resultant invention should it become involved in an interference, some of the rules for which are set out hereinafter.

In maintaining experimental records, it is highly desirable that some type of permanent record notebook be used wherein the pages are permanently bonded in place, and all work done should be maintained in chronological order on consecutive pages of the notebook. Obviously complete records should be kept, and for a chemical experiment the data should cover the apparatus used, substances and quantities used, reaction times, temperatures, yields obtained, etc., and any special actions or conditions observed.

As an important adjunct to the actual experimental laboratory record book, for all major developments, it certainly is very wise to set up an auxiliary record film system. In such auxiliary file on any given project, notes would be made about any conferences and discussions held between interested parties and relating to the development. Obviously names and dates would be important, and any and all records maintained on experimental work should be signed and dated by at least one person and preferably witnessed by one or two others. If any special equipment of chemicals, tools, or other items are purchased for use on an experimental program, records such as purchase orders, invoices, receipts, etc. with regard to the special equipment used on a project should be kept in this auxiliary file.

Protecting a Development

First of all, when one believes he has made or invented a new and useful process, product, or apparatus, he should be certain that his laboratory or experimental records, or drawings, and disclosures of this development are as full and complete as the inventor can make them at that time. Thereafter, the inventor may wish to consult with sales and other technical personnel to determine whether his invention appears commercially attractive and feasible.

Next it is suggested that an investigation be made of the patent art to determine whether the development or invention is truly novel and would apparently be able to have patent protection secured thereon. If the result of such patentability investigation is favorable, then it may well be time to embark upon the preparation of a patent application upon this development.

Before filing such an application, however, the inventor should thoroughly review the subject matter of his invention to be certain if his invention relates to chemical subject matter, that the inventor is familiar with all equivalent substances that can be used in his new chemical process; he should know the time and the temperature limits of the reactions involved, the quantities of materials used, the yields, purity of the yield product, and he should see if he can determine some suggested uses for the process or end-product secured.

All the available development data then should be turned over to the patent attorney, and the inventor should work closely with the patent attorney to be certain that a full, accurate, and complete disclosure of the invention is made in the patent application. At least one complete operative example of the invention should be disclosed clearly in the specification.

Some research personnel do not appreciate the necessity of a very thorough review of the invention and patent application prepared thereon when the patent attorney is trying to get all proper subject matter in the application. No new matter can be added to the application after it is filed.

After the application has been prepared in a satisfactory form to all parties concerned, then the application is filed in the Patent Office, and the inventor then must wait his turn for consideration of the patent application by the patent personnel to whom the application is assigned for investigation. Our United States Patent Office makes good searches to study the true novelty of the subject matter claimed in a patent application and usually takes a somewhat negative attitude on new applications. Thus, frequently the initial action from the Patent Office will reject the claims presented upon certain patents or publications found by the Patent Office personnel in making their investigation of the claimed subject matter. You will note that it is the specific wording of the claims that measures the scope of a patent.

Currently the United States Patent Office is between about four to twelve months behind in its examination of newly filed patent applications before the first Patent Office action is issued thereon. After a Patent Office action is issued, the applicant has a period of six months in which to reply to the Patent Office. Usually the patent attorney will consult with the inventor and will discuss the pertinency of the disclosures of the references cited by the Patent Office against the particular invention. Then the attorney may revise the claimed subject matter of the application and will send in an argument, or brief, to the Patent Office wherein the distinguishing features of the actual invention are discussed and pointed out to the Patent Office personnel.

It will be recalled that no new subject matter can be added to the application by such amendment. New claims may be presented in the amendment to define the invention in a slightly different manner without departing from the general sub-

ject matter originally disclosed and claimed in the application.

After the amendment is filed, the application again awaits its turn for action by the Patent Office, and this consideration by the Patent Office and reply by the inventor's attorney may take place another time or two before a final position is taken by the Patent Office on the matter. Such term of prosecution of the application may take three years, or more, from the initial filing date.

If the inventor and his attorney cannot come into agreement with the Patent Office on what is the scope of patentable subject matter in a given application, then the inventor has the right to appeal from the decision of the original Patent Office Division considering this application in the Patent Office. These appeals may take different forms, but the appeal normally would be taken to the United States Patent Office Board of Appeals, and possibly even to the United States Court of Customs and Patent Appeals in Washington. Obviously, any appeal extends the pendency of the patent application a year or more.

Patent Interferences

It is possible that two or more patent applications may be concurrently pending in the Patent Office and be claiming substantially the same patentable subject matter. When such a condition exists, i. e., that two or more different applications are disclosing and claiming substantially the same patentable subject matter, then the examiners in the Patent Office advise the inventors of such fact and set up what is termed an interference between such applications. An interference may be defined as a lawsuit within the Patent Office to determine which of several parties is the actual original inventor of a given invention.

The United States patent laws are different from the patent laws in many other countries inasmuch as United States favors the original inventor of an invention, rather than the person who first applies for a patent upon a development, and prefers to grant the patent to such first inventor. United States interferences involve the filing of certain data about the conception of the invention, the taking of testimony by all parties concerned, an argument of the issues of the case before special interference boards in the Patent Office, and possibly appeals from the decision of such board. Ultimately only one patent is granted to one person upon any given patentable subject matter.

In determining who is considered the original inventor of a given invention by the U. S. patent laws, the date of conception of the invention is extremely important, and the date of reduction to practice of the invention is of about equal importance in determining such inventor. A date of conception in law is the earliest provable date that an inventor can show by a written record of his invention, or a disclosure of it to others. A reduction to practice of an invention is made by either filing a patent application upon such invention in the Patent Office, or by making a working model or sample of a given device, substance, or apparatus, or by completely practicing a process to show that it is operative for the purposes intended.

An invention is not complete until it has been reduced to practice, and thus a person first to conceive an invention and first to reduce it to practice would be the winner in any interference contest in which he is involved. Other conditions can arise, however, and some interferences become very major lawsuits. It is difficult to determine which of two inventors, who have been more or less concurrently working upon a project, is properly entitled to the patent thereon. The law specifically states that in determining priority of invention, not only are the respective dates of conception and reduction to practice of the invention important, but it also calls for reasonable diligence by the one who was first to conceive, but last to reduce to practice, from a time prior to conception of the invention by the other. Thus a party second to conceive an invention, but who then promptly went on to reduce the invention to practice, while the person first to conceive was more or less sleeping on his rights, may be the victor in an interference contest involving such parties and subject matter.

Interferences can be declared between existing or pending patent applications in the Patent Office, or between an issued patent and a pending patent application. If the pending applicant is determined to be the winner of the interference contest involving an issued patent, then the subject matter of the interference would be granted to the first party, and he would be issued a patent thereon which would, in effect, negative or nullify the grant of the patent to the first party. No formal cancellation of such issued patent can be made as the Commissioner of Patents does not have such right, but to all effects, such earlier granted patent is thereafter null and void insofar as the interference subject matter is concerned.

Patent Termination

In general, all United States Letters Patents terminate 17 years from the date of their grant, which patent grant date appears on the face of each and every patent. After such time, anyone in the world is free to practice such invention in the United States without any fear of patent responsibility from an infringement viewpoint. A few special laws have been passed, however, extending the term of patents because the patent owner has been held up from exploiting and developing his patent rights because of actual service in the Armed Forces or because of wartime curtailments. These patents on which special extensions have been granted have been very limited in number, and, in general, one will not run into them in ordinary business practices, so that it is reasonably safe to assume that all U. S. Patents expire 17 years from their date of issue. It should be understood that a U. S. patent protects one's development in the United States only.

Foreign Patents

The advisability of protecting developments in other countries is a question that continually arises. Many U. S. companies find foreign patents and foreign licensing programs to be very helpful to them and to be a very profitable operation. In looking at it from a practical viewpoint, some foreign countries have blocked currencies and/or severe limitations on U. S. dollars that may be sent from such country to the United States, and this policy makes it more difficult to obtain any satisfactory income from foreign patent licensing programs. It is possible, however, to get monies released from foreign countries where special benefits are derived by the country from the inventions covered by the patent licensing program, or where the foreign licensee may have credits available in this country, etc.

There is an agreement between most countries in the world called the International Patent Convention. Under such Convention Agreement, it is very desirable to apply for foreign patents within one year from the filing date of the United States patent application on the invention to be protected abroad. By such action, one is able to secure the benefits of the U. S. filing date in the foreign applications, but yet be able to evaluate the U. S. invention for an additional period before deciding what action is to be taken concerning protecting it abroad. Foreign patents differ from U. S. patents in several ways, and one is that they exist for varying lengths of time from a five-year term in Argentina to a term of 20 years in Belgium, with most foreign patents having a span of from 15 to 18 years from the date of filing. The amount of filing fees paid determines the length of patent life in some countries, including the term of United States Design patents.

Yet another important distinction between U. S. and foreign patents, with the exception of Canada, is that yearly taxes are due on all foreign patents within a year or two of their date of issue. Thus unless these annual maintenance taxes are paid, the patent becomes void.

Yet a further requirement in many other countries is that, after a given term of life, the patent must be "worked," and this is yet another way that patent rights may be lost in foreign countries. Working a patent in general comprises either advertising the patent as being available for licensing or sale in the foreign country, or it may require limited use of the patent's teachings in such country.

Patents in foreign countries are looked upon more as a source of revenue than they are in the United States, hence most foreign government fees for patents are higher than in the United States, hence, also, the requirement for yearly taxes on patents.

The procedures for obtaining patents in various foreign countries varies widely, with some countries such as Switzerland, Germany, and Holland giving very careful review of the novelty in patent applications. Other countries grant patents merely by rote if all formalities required by the Patent Office are met. Some of such countries are Spain, Belgium, and France. These patents granted in such later named countries then must be supported by the patent owner as to their validity should any litigation ever arise thereon.

Goodrich-U. S. Rubber Co. Suit

It would seem that any comments upon patents at this time to a group interested in the rubber industry would not be complete unless some comment was made on the recent patent infringement action involving The B. F. Goodrich Co. *vs.* United States Rubber Co. Goodrich owns about a dozen patents relating to tubeless tires, but only Patent No. 2,587,470 was used as the basis for this suit. The patent in suit related to and covered a tubeless tire broadly comprising an impervious butyl-type rubber liner adhering to the inner surface of the tire and extending continuously from bead to bead of the tire, and ribs on axially outer faces of the beads and protruding therefrom. Admittedly, this Goodrich patent was not the first tubeless tire patent. In view of the large volume of dollar sales of the patented item and of the alleged infringing item, the patent in suit obviously had great value if held valid and infringed.

Both plaintiff and defendant had investigated the matter extremely carefully and had prepared their cases very thoroughly. Extensive evidence was submitted by both sides and the trial lasted for several weeks. The Judge's decision covered approximately 35 pages, and he thoroughly reviewed the evidence presented. The Judge specifically referred to and discussed 28 prior patents in one section of his opinion, which patents had been presented by the defendant, U. S. Rubber, in the suit, and all of which related to proposed tubeless tires that had been patented in the past. The Court also discussed in some detail the problems of adhesion of the butyl sealing layer, by the Goodrich company in its commercial tire constructions, and the several changes in composition of such sealing layer made by Goodrich.

The Judge also commented particularly upon the work that U. S. Rubber had done as early as 1932 on tubeless tires and which included obtaining a patent on a tubeless tire at such time. The Judge's decision laid emphasis upon the fact that some of the most pertinent references had not been considered by the Patent Office in the several-year prosecution of the patent. The Judge also noted that the sealing liner disclosed in the patent suit covered 100% of the tubeless tire inner surface and extended from bead to bead thereof. The structure used by U. S. Rubber, however, admittedly covered only about 97% of this bead-to-bead surface.

The Court found that the U. S. Rubber tire did not have the specific type of sealing ribs, or the specific liner as called for by one typical claim, upon which the suit was based. Thus the Judge ruled the claims in suit were not infringed and were invalid.

I would summarize the tubeless tire case by stating that Goodrich had made a wonderful commercial advance which unfortunately was a very narrow technical advance.

Conclusion

In concluding this discussion, it should be recalled that Federal Courts, in exercising their judicial prerogative, can and do rule in some instances that a patent apparently properly issued by the Patent Office is in fact invalid. Mostly such patents are ruled invalid as not disclosing an "invention." The Patent Office is endeavoring to lift its standards of invention to equal those of the courts, and this policy strengthens the now statutory presumption of validity of an issued patent.

It also should be noted that it usually is only the patents of questionable validity that reach the courts. The strong patents are recognized without litigation, and weak patents usually are not the basis of law suits. Thus I believe, and think that other lawyers and research workers will agree, that patents have been and are a major force in our industrial economy and that they contribute materially to the improvement and growth of our wonderful country.

Rubber Reclaim Symposium at Chicago Group Meet

"What Would You Like to Know about Reclaimed Rubber?" was the subject of a panel discussion attended by more than 210 members and guests of the Chicago Rubber Group at the Furniture Club, Chicago, Ill., March 15.

With H. A. Winkelmann, Dryden Rubber Division of Sheller Mfg. Co., acting as moderator, the panel members and the subjects they dealt with follow:

J. M. Ball, Midwest Rubber Reclaiming Co., "What Is Reclaimed Rubber?"; H. D. Glenn, Naugatuck Chemical Division, United States Rubber Co., "What Types of Reclaimed Rubber Are Available?"; Croft Huddlestone, U. S. Rubber Reclaiming Co., "What Are Major Reasons for Using Rubber Reclaim?"; E. B. Busenberg, B. F. Goodrich Co., "How Is Reclaimed Rubber Used in Tires and Other Transportation Items?"; J. E. Brothers, Ohio Rubber Co., "What Is the Merit of Reclaimed Rubber in Molded Goods and Other Non-Transportation Items?"; and J. E. Misner, Xylos Rubber Co., "What Are Premixes and How Can They Best be Used?"

The talks, previously presented elsewhere, were covered in RUBBER WORLD, August, 1956, page 730. Additional questions and answers not then covered are as follows:

Q. How can reclaimed rubber be used in camelback?

A. Huddlestone. Up to about 10% of reclaimed rubber may be used in camelback with the following advantages: improved shelf life, less cold flow, improved mold flow, cooler running compound, lower cost, less variation in extrusion, and faster rate of extrusion.

Q. What is the outlook for butyl reclaim?

A. Busenberg. On the whole, the outlook is good. While the proportion of tubeless tires is growing, the total increase in tires is sufficient to permit the number of tubes produced to be maintained fairly well. It is probable that there will be plenty of butyl available for reclaiming for some time.

Q. Can reclaimed rubber be used in military specification products?

A. Brothers. Yes, if the specification does not prohibit it. We take the attitude that there should not be too much limitation on the ingenuity of the compounder. If the customer follows the ASTM procedure of specifying only the performance the compounder can give a better product at a lower cost.

Q. What is the advantage of reclaim in solvent cements and adhesive tape?

A. Huddlestone. The advantages are in cost and in improved adhesiveness. As long as a perfect antioxidant is not available, there will be a place for reclaim in tape.

Q. How does reclaimed rubber aid processing?

A. Misner. Reclaim cuts the power consumed in mixing a batch by about 50-60. It produces less heat build-up, faster processing, less thermoplasticity, and reduces swelling of the stock. Another advantage is that the reclaim can be tailor-made to fit the rubber stock and modified to produce the properties desired.

Q. Are some of the newer elastomers being reclaimed?

A. Huddlestone. The newer elastomers such as silicones, Kel-F, Hypalon, Teflon, can be reclaimed in the sense that they are converted into reusable compounds. The silicones have been reclaimed for eight or nine years. Kel-F has just recently been available. Teflon and Hypalon are not being reclaimed commercially because of the cost at the present time. In the case of the silicones, it is important to keep the various grades separate.

After-dinner guest speaker at the meeting was Alex Dreier, news commentator and reporter for the National Broadcasting Co., who presented a film taken on a recent trip to the Soviet Union.

Two CIC Sections Meet

A joint meeting of the Ontario Rubber and the Wellington-Waterloo sections of the CIC was held at the Royal Hotel, Guelph, Ont., Canada, March 12. Byron A. Hunter, Naugatuck Chemical Division, United States Rubber Co., addressed the group on "The Chemistry and Application of Modern Blowing Agents."

Dr. Hunter described the commercially available blowing agents, discussed the applications of the main classes of blowing agents in industry, and outlined the properties required for the ideal blowing agent, referring particularly to odor, discoloring properties, activating temperatures, and volumes of gas formed.

London International Synthetic Rubber Symposium Features 15 Papers on World-Wide Developments

An International Synthetic Rubber Symposium was held in London, England, March 26-28, with 16 technical papers presented by representatives of various sections of the synthetic rubber industries of the United States, Great Britain, Italy, West Germany, and Canada.

The Symposium was organized by *Rubber and Plastics Age,* London, a British trade publication. There were 680 registrants at the conference, including 24 from the United States, 17 from West Germany, 12 from Holland, 11 from Italy, seven from France, five from Canada, and one each from Belgium, Norway, and Ceylon. The Soviet Union was represented by five; while Czechoslovakia provided four attendees.

G. E. Beharrell, chairman of International Synthetic Rubber Co., Ltd., and deputy chairman and managing director of Dunlop Rubber Co., Ltd., was the chairman of the Symposium. Honorary president of the conclave was Sir David Eccles, president of the Board of Trade of Great Britain.

Abstracts of the 15 technical papers presented during the three-day event, in the order of their delivery, follow:

"German Synthetic Rubber Developments." Paul Baumann, Chemische Werke Hüls, AG.

In West Germany a new synthetic rubber plant will be erected. Butadiene will be produced from n-butane; styrene will be delivered from Chemische Werke Huls. The dehydrogenation of n-butane to butadiene will be made by the Houdry process. The dilute butadiene obtained by this process will be concentrated by the copper ammonia acetate extraction process of Esso Research & Engineering Co.

Annual capacity of the new plant is estimated at 38,000 tons of butadiene. The butadiene concentration capacity will be such as to include purification of all the recycle butadiene from polymerization. The plant will manufacture 45,000 tons a year of Buna Hüls K, i.e., cold rubber which is a styrene butadiene copolymer produced at 41° F. with redox system and moderators.

"Ameripol SN Rubber." Robert P. Kenney, B. F. Goodrich Co.

Ameripol SN is *cis*-1,4-polyisoprene produced by the polymerization of isoprene by a Ziegler-type catalyst. Compounding has indicated a close relation between Ameripol SN and *Hevea* rubber, with some differences stemming possibly from the non-hydrocarbon matter in the latter. These differences are not sufficiently large to indicate any difficulty in making a direct substitution of one for the other in practically any application. It can be concluded that Ameripol SN is a potential replacement for all or part of the natural rubber in heavy-duty tires.

"British Developments in Synthetic Rubber." E. A. Murphy, Dunlop.

In 1914, a butadiene rubber was produced in England by using a sodium polymerization process. A new route for the manufacture of butadiene was devised in 1942, and Dunlop began working on butadiene polymers. At Fort Dunlop more than 700 tons of polysulfide rubber were produced during the war.

Further experiments on butadiene polymers were carried out, including pilot-plant production of cold rubber, in 1952. The present production of synthetic rubber in Britain was outlined, and reference made to new methods of producing synthetic rubbers.

"Basic Italian Research on New Synthetic Elastomers." Giulio Natta, Istituto di Chimica Industriale del Politecnico di Milano.

Through the use of new polymerization processes, based on the use of catalysts, containing transition metals, linear polymers have been prepared from various types of unsaturated hydrocarbons. These polymers have very high molecular weight, are practically free of branching, and possess a chemical structure which is more regular than that of conventional polymers.

Using catalytic processes of different stereospecificity, new and unforeseen classes of plastic and elastomeric materials have been obtained. By polymerization of diolefins, various stereoisomeric polymers were obtained, some of which were not previously known. In the case of polybutadiene, besides both the *trans* and *cis* stereoisomers with 1,4-enchainment, both in the crystalline state, also the two crystalline, isotactic, and syndiotactic, and the amorphous, atactic, stereoisomers with 1, 2-enchainment were obtained.

Also discussed were alpha-olefin polymers, ethylene-alpha-olefin homogeneous polymers, and copolymers of alpha-olefins with small amounts of diolefins.

"Oil-Resistant Compositions from Nitrile and Acrylic Rubbers." S. Mottram and P. H. Starmer, British Geon, Ltd.

Special-purpose synthetic rubbers have been developed for use where natural rubber and general-purpose synthetic rubbers would be unsuitable. A particular example is in applications requiring good resistance to oils. The oil resistance of nitrile and acrylic rubbers is dependent on the chemical nature of the raw polymer.

Properties other than oil resistance may be modified or enhanced by the incorporation of various compounding ingredients. Fillers, particularly carbon black, improve the tensile properties, while plasticizers improve the flexibility at low temperatures. Blends with other rubbers and also with plastics give materials with useful properties.

"Self-Reinforced Elastomers." E. E. Gale, H. A. Pfisterer, E. B. Storey, Polymer Corp., Ltd.

The self-reinforced elastomers are recognized as a special class of rubbers which are characterized by a unique balance of modulus, hardness, and tensile strength. The chemical, physical, and rheological properties of these rubbers were discussed in some detail and recent improvements, particularly in handling and mixing characteristics, were described.

Compounding variables were reviewed, with particular reference to the type and the quantity of fillers and plasticizers used. The advantages of the self-reinforced elastomers in shoe soling and floor tile were discussed, and other applications surveyed.

"Effect of *cis-trans* Ratio on the Physical Properties of 1, 4-Polybutadienes." Gerard Kraus, J. N. Short, and Vernon Thornton, Phillips Petroleum Co.

Vulcanizates of all 1,4-polybutadienes exceeding 15% in *cis* content are completely rubbery at ordinary temperatures. Polybutadiene of 93% *trans* content yields tough, leathery, crystalline vulcanizates at 80° F., which become rubbery at moderately elevated temperatures.

Without exception, the important physical properties change little between 25 and 80% *cis* content. Vulcanizates of 70 to 80% *trans*-polybutadienes exhibit evidence of crystallinity over a wide range of temperatures and are probably not completely melted at room temperature. Although their resilience is less than that of the high *cis*-polybutadienes, it is still somewhat better than that of SBR, particularly at low temperatures.

The 1,4-polybutadienes are more resistant to oxidative scission than emulsion polybutadiene or SBR and are greatly superior to natural rubber in this respect. The dominant effect in the aging of 1. 4-polybutadienes is cross-linking. Because of their low sulfur requirements, the *cis*-polybutadienes offer a particular advantage in aging resistance.

"Further Developments in the Field of 'Vulkollan' Polyurethane Rubber." Erwin Muller, Farbenfabriken Bayer, AG.

The various types of polymerization of linear addition products containing isocyanate groups were discussed. Special attention was paid to the polymerization with polyalcohols, especially with glycol and diamines. For the two named polymerization mechanisms it is characteristic that in order to achieve technically valuable properties for every di-isocyanate the suitable glycol or diamine must be found. New combination possibilities between di-isocyanates on the one hand and polymerization agents on the other hand (glycol or diamine) were mentioned.

"Silicone Rubber—Its Growth and Recent Developments." Philip C. Servais, Dow Corning Corp., and I. H. Riley, Midland Silicones, Ltd.

The first step toward high-strength silicone rubber was made by the use of reinforcing silica fillers. Continuing research effort in the field of polymer-filler

interaction promises silicone rubbers of even higher strengths. Resistance to compression set at elevated temperatures was improved by the use of heavy metal additives and later by vinyl-containing polymers. Heat stability was enhanced by special compounding to produce silicone rubber capable of withstanding 600° F. for a limited time.

Silicone rubbers' retention of rubber properties over a wide temperature range has simplified design, improved performance, increased life, and reduced maintenance of rubber parts. Applications have been found in the medical, pharmaceutical, aircraft, automotive, chemical, power, home appliance, transportation, and shipbuilding industries.

"The Neoprene Latices." E. P. Hartsfield, E. I. du Pont de Nemours & Co., Inc.

The majority of products made from neoprene latex, in common with those made from natural rubber latex, require vulcanization in order to develop their major properties. It is therefore necessary to use compounding ingredients in latex formulations.

The extensive use of neoprene latex in such products as bonded fibers, foams, adhesives, and dipped goods is dependent upon the resistance of neoprene to a wide variety of deteriorating influences. The relation between these deteriorating influences and the specific applications were discussed.

A new type of neoprene latex, Type 750, which possesses outstanding stability to storage, mechanical action and compounding was described. This new latex produces films characterized by low modulus, improved hot properties, and marked resistance to stiffening due to crystallization. Freshly prepared films from this latex also have high wet gel strength and extensibility.

"Relationship of Polymer Structure to the Properties of Butyl Rubber Vulcanizates." W. L. Dunkel, W. C. Smith, and R. L. Zapp, Enjay Laboratories.

Grades of butyl rubber are available which vary in unsaturation level from 0.5 to 2.5 mole per cent. The different butyl polymers also vary in molecular weight—from 30,000 for some grades of the elastomer to more than 50,000 Staudinger units for other grades. The linear nature of a butyl chain with its regularly spaced methyl side groups is still another distinguishing characteristic of the polymer. These factors tend to contribute to butyl vulcanizates exhibiting excellent ozone, chemical, and heat resistance, high impermeability to gases, and good damping qualities.

A technique has been developed which can be utilized in compounding butyl to obtain vulcanizates exhibiting increased resilience and improved dynamic properties. This consists of either thermal or chemical interaction of the polymer with carbon black.

"The Status of Butyl Tires in the United States." D. J. Buckley, Esso Research & Engineering Co.

One problem which demanded solution before a successful butyl tire could be realized was the matter of resilience. Here extensive research in the field of polymer-pigment habit was conducted. A chemically promoted heat treatment of polymer-pigment systems represented the solution to this problem.

Butyl latices have been developed and found applicable as cord treatments for both rayon and nylon. One of these latices, designated ENJ-B-12, is available in pilot-plant quantities. The development of a new butyl polymer, ENJ-B-11, opens up new areas of compounds capable of rapid vulcanization. This polymer represents new levels of excellence in flexing behavior. Commercially acceptable techniques for the production of butyl tires have been developed.

"Butadiene/Vinyl Pyridine Copolymers." W. Gumlich, Chemische Werke Hüls.

Among the different possible vinyl pyridine compounds, the α-methyl-β'-vinyl pyridine grade is obtained from aldehyde collidine by application of a method comparable to the production of styrene from ethyl benzene, after it had become possible by the selection of suitable catalysts to avoid a splitting up of the pyridine ring by hydrogenation which would invariably occur when using the catalysts customarily applied in styrene production.

On a pilot-plant scale, a copolymer of this vinyl pyridine grade with butadiene and styrene will soon become commercially available under the trade name of Bunatex Vp. This product will be specifically used in the impregnation of textile goods to improve their adhesion to rubber. This will be an extensive field of application when its use is contemplated for the manufacture of tire goods, driving and conveyor belts, and similar articles.

"A New Family of Elastomers." R. M. Pierson, W. E. Gibbs, G. E. Meyer, F. J. Naples, W. M. Saltman, R. W. Shrock, L. W. Tewksbury, and G. S. Trick, The Goodyear Tire & Rubber Co.

A versatile family of elastomers has been prepared by free radical addition of aliphatic mercaptans to the double bonds of diene polymers. High saturation levels were readily achieved without degradation of the basic polymer chain. The technology and kinetics are similar to those of ordinary emulsion polymerization.

By varying the nature of the base polymer, the mercaptan used, and the extent of saturation, a wide range of compositions and of physical properties were attained in the adducts. In general, resistance to aging, ozone attack, heat, solvent swelling, and to permeation by gases increased with increasing extent of saturation. Outstanding performance in these qualities was achieved by adducts of polymers whose double-bonds had been more than 90% saturated.

Adducts with saturation levels up to about 85% could be cured by the same procedures used for the base polymers. Activated or butyl-type curing systems were required for higher saturation levels. The relative rates at which aliphatic mercaptans add to the several types of double-bonds present in emulsion diene polymers have been examined in a preliminary way.

"Auxiliary Materials for Synthetic Rubber." W. McG. Morgan, Monsanto Chemicals, Ltd.

The ability of a rubber product to withstand deterioration under natural or artificial conditions depends on correct selection of polymer type, compounding ingredients, vulcanization conditions, and specific organic age resisters. Greater understanding of the interaction of these factors and of aging processes, and the development of new "anti-weather" antioxidants is leading to improvements in service life of rubber products made from synthetics.

Carbon black remains as yet a unique reinforcing filler. The development of high-styrene rubber reinforcing resins, however, has opened the way to the development of hard-wearing, low-gravity, light-colored stocks, which are finding increasing use, especially in place of leather.

"Organic Fluorine Rubbers." J. C. Tatlow, University of Birmingham. No abstract available.

Chemists Group to Meet

"The Chemist and Management Appraise Each Other" will be the theme of the thirty-fourth annual meeting of the American Institute of Chemists, Inc., to be held at the Sheraton-Mayflower Hotel, Akron, O., May 22-24.

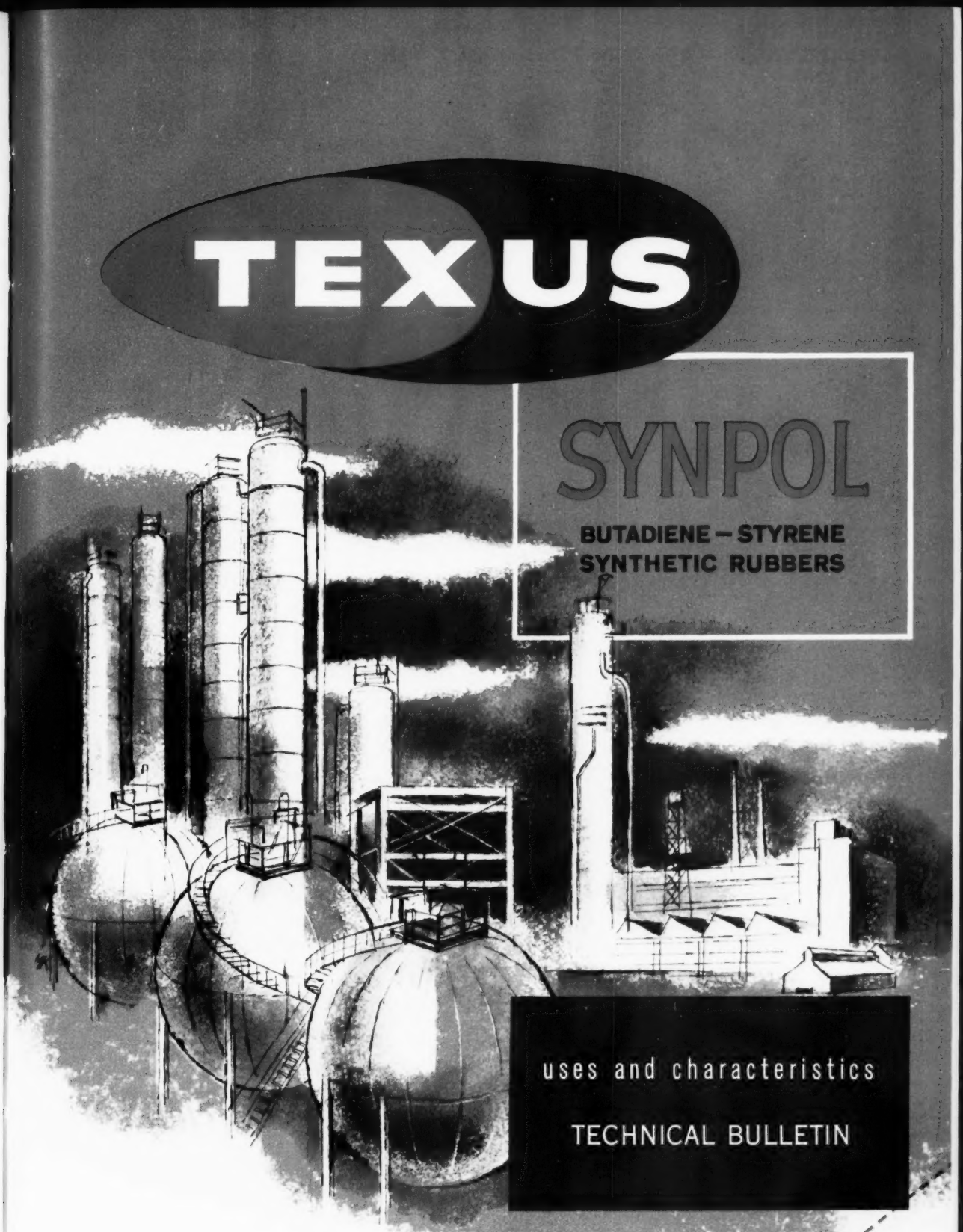
Discussions and papers will follow a general theme of how a chemist should function in America's industrial world, according to reports. Much of the material will deal with the chemist's personal problems, such as job success, self-appraisal, compensation, self-improvement, and advancement.

AIC President J. H. Nair will be toastmaster at the May 23, Gold Medal banquet, at which Roy C. Newton, vice president of Swift & Co., will be awarded the organization's 1957 Gold Medal "in recognition of his leadership in food technology and service to the profession." Lincoln T. Work, a New York chemical consultant and chairman of the AIC award committee, will make the presentation.

Polytechnic Summer Study

Advanced professional instruction in the use of specialized physical tools in chemistry and physics will be given by Polytechnic Institute of Brooklyn, Brooklyn, N. Y., June 3-August 12, consisting of one- and two-week courses in applied infrared spectroscopy, industrial application of X-ray diffraction, new polymerization techniques and stereospecific polymers, application of ion exchange resins and membranes, and new electrolytic techniques.

The courses will be given by members of the Institute's departments of physics and chemistry. Inquiries should be addressed to Mrs. Doris Cattell, Summer Laboratory Program, Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn, N. Y.



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ACS Miami Meeting Has Near Record Number of Papers; Engineering Symposia Numerous

The 131st meeting of the American Chemical Society held in Miami, Fla., April 7 through 12, included technical sessions and symposia by 20 divisions of the Society and featured awards to 16 chemists and chemical engineers for outstanding work in the field of chemistry. Programs of the Divisions of Industrial & Engineering Chemistry, Polymer Chemistry, and Paint, Plastics & Printing Ink Chemistry, particularly, covered items of interest to the rubber and associated industries. Registration at the meeting was more than 5,500 members and guests.

The Society's Priestley Medal, highest honor in American chemistry, was presented to Farrington Daniels, University of Wisconsin, by Roger J. Williams, president of the ACS and director of the Biochemical Institute of the University of Texas.

The ACS Award in Industrial & Enginering Chemistry, sponsored by Esso Research & Engineering Co., was given this year to Warren K. Lewis, Massachusetts Institute of Technology. The ACS Award for Creative Work in Synthetic Organic Chemistry, sponsored by the Synthetic Organic Chemical Manufacturers Association, was won by Robert B. Woodward, of Harvard University. Peter J. Debye, Cornell University, received the Kendall Co. Award in Colloid Chemistry.

D. H. Killeffer, consultant to Columbian Carbon Co., and others received the first James T. Grady Award of the Society for distinguished reporting of chemical progress at a luncheon sponsored by the ACS News Service, on April 8. This Award was established by the Society in 1955 in memory of Mr. Grady, who was managing editor of the News Service from 1923 to 1947. The accompanying photograph shows Dr. Killeffer receiving the congratulations of Ralph Connor, Rohm & Haas Co., chairman of the ACS board of directors, and C. F. Rassweiler, Johns-Manville Corp., chairman of the committee on member and public relations. Walter J. Murphy, director of the ACS News Service and of its applied journals, was toastmaster at the luncheon.

Dr. Killeffer, who was associated with Mr. Grady and the ACS News Service for many years, discussed "The Fourth Estate of Chemistry," in his award address.

I&EC Division Program

The program of the Division of Industrial & Engineering Chemistry included symposia on several different subjects, as follows: (1) metal-organic compounds; (2) engineering aspects of polymer processes and applications; (3) safety in the chemical industry; (4) nuclear technology in the petroleum and chemical industries; (5) dynamic organization—principles and practices.

"Mixing in Laminar-Flow Systems" and **"Theory of Mixing in the Single-Screw Extruder"** were the titles of two papers by W. D. Mohr, R. L. Saxton, and C. H. Jepson, E. I. du Pont de Nemours & Co., Inc., which were presented before the symposium on engineering aspects of polymer processes and applications. In the first paper the authors reported the development of a relation for striation thickness as a measure of goodness of mixing of plastic and rubber materials. Factors involved included cube side length of minor component, volume fraction of minor component, net amount of shear applied, and the viscosities of the major and minor components.

In the second paper the theories of mixing in laminar-flow systems and of melt extrusion were combined to enable the mixing performance of the single screw extruder to be calculated. The variables studied included screw helix angle, thread depth, and the ratio of pressure flow to drag flow.

The calculations yielded the shear strain imposed on an element of fluid as a function of the above variables, and the flow path in the screw channel. These data were then converted to goodness of mixing, expressed as striation thickness, as a function of reduced radius in a rod-shaped extrudate.

"Mixing of Non-Newtonian Polymer Solutions," by R. E. Lee, C. R. Finch, and J. D. Wooledge, Dow Chemical Co., compared the mixing of two essentially Newtonian fluids, corn syrup and low molecular weight methylstyrene resin, with the mixing of polystyrene-ethylbenzene solutions which are non-Newtonian.

In general, power number-mixing Reynolds number curves for Newtonian fluids agree closely with the literature. Marked deviations of the viscosity of polystyrene solutions from the zero shear viscosity occur only at high shearing rates or impeller speeds. Apparent viscosities at high shear rates have been observed to be less than one half the zero shear viscosity.

One of the findings of this investigation that attracted considerable attention was the fact that addition of baffles to a vessel with an unshrouded turbine impeller had little effect on power requirements and on mixing times. Shrouding the turbine, however, did increase the power requirements at the same Reynolds number.

"Concentration of GR-S Latex by Continuous Column Concentrator," by R. C. Stell, J. C. Blackwell, and P. J. Henry, Goodyear Synthetic Rubber Corp., described the use of a tall, cylindrical vessel, equipped with a centrifuge pump and heat exchanger, to perform the concentration of styrene-butadiene latex from 40 to 62% total solids. Initially, a charge of latex is placed in the vessel, which is maintained at high vacuum. The latex is recirculated and heated until the resultant flashing of water has increased the solids to 62%. When this point is reached, a feed stream of low solids latex is added to the recirculated stream at a rate which will maintain the recirculated stream at 62% solids. A portion of the recirculated stream is then diverted to the storage tanks as concentrated latex.

The use of a tall vessel to reduce entrainment and foaming losses and the maintenance of a large body of latex in the vessel to provide equilibrium stability are important features of the process and represent an improvement over former equipment, it was pointed out in this paper.

"Engineering Aspects of Emulsion Polymerization," by Sidney J. Baum, Foster Grant Co., reviewed the problems encountered in the design and operation of a multi-purpose emulsion polymerization plant including handling of low boiling monomers, charging ingredients to reactors, transport of thixotropic finished emulsions, design of circulating cooler water systems, and selection of pumps and compressors, under fluid flow problems.

Methods of handling exothermic heat of polymerization and of cooling viscous batches were described in the section on heat transfer. Agitation and distillation problems in connection with emulsion polymerization were discussed, and it was said that filtration of polymer emulsions is a difficult operation, best solved by simple screening methods.

Other design considerations for an emulsion polymerization plant were described in sections on product storage, shipping containers, safety, and instrumentation.

"Ionic Polymerization Processes—Monomer Structure and Catalyst Types," and **"Ionic Polymerization Processes—Polymer Structure in Relation to Process Types,"** were the titles of two papers presented by C. E. Schildknecht, Stevens Institute of Technology.

In the first paper Dr. Schildknecht pointed out that although only a few ionic polymerization processes for the preparation of vinyl-type high polymers are in satisfactory commercial operation today, intensive research and development in this relatively new field are expected to have a considerable impact on industrial and engineering chemistry.

Vinyl monomers may be arranged in groups according to their response to one or more catalyst types to give homopolymers of high molecular weight. The polarity of the monomer double-bond, as determined by electron donation or withdrawal by substituents, was the principal factor discussed.

Some relations with regard to isotactic polymerizations and copolymerizations were pointed out. The need of better theories in the field of polymerization in

electrophilic and nucleophilic systems was discussed.

In the second paper it was said that compared to free radical polymerizations the ionic polymerizations and copolymerizations generally require more attention to purity of monomer, solvents, and catalysts and to precisely identical reaction conditions in order to yield products of reproducible molecular weight, structure, and properties. Many of the ionic polymerization systems of greatest commercial interest are of the proliferous type, in which rates of diffusion into the growing polymerization zone are important.

An outstanding plant process of cationic polymerization at low temperatures is the continuous preparation of butyl rubber. This copolymerization of isobutylene and isoprene was compared with the cationic polymerization of vinyl butyl ethers.

In recent years experimental processes of anionic polymerization in highly nucleophilic systems have attracted great industrial interest. Alkali or alkali earth metals, hydrides, alkyls, aluminum alkyls, and other catalysts have been used in such processes. In many cases the complexes actually effective remain to be identified and prepared in pure form; however, the outstanding properties shown by some of the best experimental polymer samples stimulate more intensive research and development.

Dynamic Organization

The Chemical Management Subdivision of the Division of Industrial & Engineering Chemistry conducted a symposium on principles and techniques of industrial management and organization entitled, "Dynamic Organization—Principles and Practices," with R. E. Worden, of Worden & Risberg, management consultant, presiding.

In his introduction Mr. Worden explained that the purpose of the symposium was to examine the principles of organization as applied to specific corporate problems in the chemical field, to discuss some of the techniques of well-managed organizations, and to apply these principles and techniques in a final panel discussion to such specific problems as might be brought up by the audience.

Five basic requirements of a good executive were given as: (1) orderly thinking; (2) inner drive; (3) ability to direct people; (4) willingness to assume responsibility; and (5) character. In turn the successful executive must be adequately compensated, must have a feeling of security in connection with the progress he can make in a given organization, and must have a feeling of belonging or receiving recognition for his work for that organization.

"Organization for Growth," was discussed by F. Estes Smith, Wyandotte Chemicals Corp. There is no set pattern for organization for growth of company or corporation. The board of directors of a company must want to grow, must know the direction in which such growth is to take place, and must be willing to sacrifice some profits momentarily in order to grow. The strength of the people and the funds of the organization must

Thibedau Studio

D. H. Killeffer being congratulated by Ralph Connor *left*, and C. F. Rassweiler, *right*, on receiving James T. Grady Award

be evaluated for growth, and the management then furnishes the goals and patterns for growth.

In summary, Mr. Smith said that the basic factors for growth were as follows: (1) the program for growth must be sold to the board of directors; (2) the company must be well staffed; (3) overall responsibility for the expansion program must be given to one or two individuals; (4) rewards for enterprise must be ample to motivate the persons involved; and (5) the growth of a company is the growth of people in the company.

"Staff and Line Functions," were described by Robert K. Mueller, plastics division, Monsanto Chemical Co. Effective administration and control require a creative and understanding role in staff functions. The activities and contributions of both the staff and line must be integral and consonant with the organizational goals of the enterprise, this speaker said.

Properly organized companies today should not require that day-to-day decisions be made by the chief executive, but such decisions should be made by staff and line executives. Line executives in the chemical industry are production executives charged with the responsibility of manufacturing operations. Staff executives are charged with the responsibility for progress by the company. Staff specialists are members of a new profession in industry, but Mr. Mueller cautioned against too much dependence on these specialists in making final decisions.

"Delegation and Control," by Robert L. Hershey, Du Pont, considered delegation of responsibility and authority as a factor in present performance, how it can accelerate the decision-making process and improve the quality of the decisions reached, how it can affect the action following the decision, and as a factor in future performance through its impact as a training tool. The true ability to delegate authority is the ability to allow a subordinate to make mistakes, it was added.

Some necessary conditions for successful delegation of authority were examined; for example, clear definitions of the areas of responsibility and authority; precise statements of objectives; others relate to the human individuals in the organization, again for example, their qualities of self-control and integrity.

Means of assuring the success of the delegation process were discussed also, with emphasis on the development of accountability by measuring performance against established standards.

"Group Deliberations and Managerial Decisions," by Hugo Riemer, Allied Chemical & Dye Corp., pointed out that the committee is becoming more and more an accepted device for bringing group judgment to bear on matters of corporate policy and for improving communications. The use of group participation as a means of bringing those responsible for getting action into planning sessions and of stimulating team work was discussed.

"Organization for New Product Development," by Lloyd A. Hatch, Minnesota Mining & Mfg. Co., emphasized that planning and coordination are vital if new product development is to contribute fully to increased sales and profits. New product planning starts with management decisions on direction and rate of growth. The development program moves ahead when the coordinated skills of many people in many departments are brought to bear on the overall plan.

Polymer Division

Papers of possible special interest presented before the Division of Polymer Chemistry follow:

"Polyurethanes from New Block Polymers," by K. C. Frisch and S. Davis, Wyandotte Chemicals.

"Thermodynamics of Crystallization of Polyethylene," by Fred. A. Quinn, Jr., and Leo Mandelkern, National Bureau of Standards.

"Thermal Degradation of Polysulfide Polymers," by Norman A. Rosenthal and Morris B. Berenbaum, Thiokol Chemical Corp.

"Chain Branching in the Polymerization and Graft Polymerization of Styrene and Methyl Methacrylate," by Maurice Morton and Irja Piirma, University of Akron.

The Polymer Division conducted a symposium on ionic polymerization mechanisms, with C. G. Overberger, Brooklyn Polytechnic Institute, presiding.

Midwest Plastics Meet

A Midwest Plastics Conference will be held June 13 and 14 at the Arlington Hotel, Hot Springs National Park, Ark., under the sponsorship of the Midwest Section, The Society of the Plastics Industry, Inc., New York, N. Y. Theme of the meeting, which is aimed primarily at the management level, has been selected as "How to Exist in Today's Market."

Reinforcing Agents—Carbon Blacks and Silicas, SORG Spring Panel Discussion Meeting Subject

SORG panelists and moderator, *left to right:* John F. Snyder, F. W. Gage, Ralph F. Wolf, and Morton L. Studebaker

"Reinforcing Agents for Rubber—Carbon Black and Silicas" was the topic of the panel discussion at the spring technical meeting of the Southern Ohio Rubber Group at the Engineers' Club, Dayton, O., March 28. About 100 members and guests were in attendance.

Moderator of the panel was F. W. Gage, Dayton Chemical Products Laboratories. Members of the panel were John W. Snyder, Columbian Carbon Co., who talked on "Carbon Blacks—The Channel, SRF, and FEF Blacks"; Merton L. Studebaker, Phillips Chemical Co., who had as his subject, "Carbon Blacks—The HAF, ISAF, and SAF Blacks"; and Ralph F. Wolf, Columbia-Southern Chemical Corp., who discussed "Silicas."

Serving with Mr. Gage, program chairman for the meeting, were Stanley S. Pomeranz, Vernay Laboratories; George Lang, Premier Rubber Co.; Dayle Buchanan, Inland Mfg. Division, General Motors Corp.; and Charles G. Wyman, Dayton Rubber Co.

At the dinner-meeting preceding the panel discussion, E. N. Cunningham, Precision Rubber Products Co., Group chairman, presided. He described plans for future meetings of the Group during the current year and plans for another lecture course in rubber technology to be presented during 1957-58.

Salient points of the talks presented by the panel members are given below. No transcript of the question-and-answer period is available.

Channel, SRF, and FEF Blacks

Mr. Snyder first pointed out that although the carbon black industry started somewhere in the 1880's, the first big-volume application came in 1912 with the discovery that carbon black would reinforce rubber and thereby greatly improve the mileage of tires. The first work in this country was done with what is now termed channel black. In the early 1920's, semi-reinforcing channel black came into the picture. Although SRF black did not reinforce like channel black, it did fulfill many of the requirements for certain types of rubber compounding. Following SRF came the so-called thermal carbon and more recently the modern-type furnace blacks made from either gas or oil.

The basic principles involved in the manufacture of channel and furnace blacks were outlined, and the important properties of channel blacks, that is, low pH, moderate vulcanization rate in accelerator cured compounds, and small particle size, were discussed briefly.

The SRF black with its higher pH, larger particle size, and lesser reinforcing ability was next described as a preliminary to the discussion of fast extrusion furnace black, FEF, with its particle size intermediate between channel and SRF black, its more than average structure, and corresponding higher than channel black modulus. The excellent extrusion characteristics of stocks containing this black, particularly those made with styrene-butadiene, SBR, or butyl, IIR, rubbers, were mentioned also. Although the heat build-up of FEF black stocks is somewhat higher than that of channel black stocks, the better reinforcing characteristics of the FEF more than counterbalance the higher heat build-up.

While today the fine particle size reinforcing furnace blacks have displaced channel black from the treads of many tires, there are certain tread applications where channel black is preferable because of its retarding effect on vulcanization, it was said. Blends of channel and furnace blacks are used in some of these applications.

Electrical conductivity of carbon black stocks has become rather important and it was pointed out that the finer the particle size, the better the conductivity; the higher the structure, the better the conductivity; the lower the oxygen content, the better the conductivity. The fine particle size furnace blacks of higher structure and low oxygen content are best for conductivity, and the channel blacks with their normal structure and higher oxygen content are better for insulation.

HAF, ISAF, and SAF Blacks

The carbon blacks of the types FEF, HAF (high abrasion furnace black), ISAF (intermediate super abrasion furnace black), and SAF (super abrasion furnace black) are made in furnaces by incomplete combustion of oil, with natural gas frequently used as an auxiliary fuel, Mr. Studebaker explained. A comparison of FEF, HAF, ISAF, and SAF particle size, surface area, hydrogen content, oxygen content, and oil absorption properties was presented.

It was then pointed out that, in general, the unvulcanized rubber containing these carbons handles well in virtually all factory operations. Vulcanized stocks containing these blacks are characterized by relatively high modulus. Tensile strength generally increases with decreasing particle size, and tear resistance, abrasion resistance, and hysteresis properties follow the same pattern. The stocks vulcanize more rapidly and have lower accelerator requirements than channel blacks; they exhibit the good extrusion properties common to high structure blacks. These stocks calender well at normal loadings, and all have good hot tear and tensile properties.

The large-volume use of these blacks is in tire compounds, and the HAF, ISAF, and SAF blacks are used mainly in treads. In crude natural rubber, the cut and crack resistance is improved as changes are made from HAF to ISAF and on into SAF treads; the loadings of the blacks is reduced as the finer particle size black is used. In cold SBR, results to date indicate that cracking and cutting of treads increases as the move

is made from HAF to ISAF and into SAF treads, but it is possible that this disadvantage may be eliminated by proper compounding and changes in tire construction, the speaker declared.

HAF blacks have been used in both natural and synthetic rubber conveyor belt covers, and ISAF and SAF are now finding a place in this application. HAF black is used in curb hose covers to provide good abrasion resistance to nitrile, NBR, and neoprene, CR, stocks, and is also used for insulated wire jackets which are subjected to severe abrasion.

A specialized application of the SAF blacks has been found in tank blocks. In those gasket compounds where high modulus and low compression set are important, the oil furnace blacks have been used, as they have in certain types of motor mounts where these properties are of importance.

Applications of furnace blacks in compounds involved in rubber-to-metal adhesion have been causing some trouble which seems due to the rapid curing of these compounds. When the cure is slowed down somewhat to permit intimate contact during cure, good results have been obtained.

The outstanding application of FEF blacks has been in extruded goods, sponge and molded goods where the ability of the blacks to reduce the nerve of synthetic rubber has been one of their most important characteristics.

A minimum of 20 phr. of oil-type furnace blacks in molded goods was said to provide a homogeneous matrix with good flow in the mold, quicker cures, and stocks of good appearance. Aside from mold design and compounding to higher modulus, the only effective way known by this speaker, to combat backrinding, is to cure at lower temperatures.

In conclusion, it was said that the oil furnace blacks are used wherever quality stocks are important since they contribute both to the appearance and the serviceability of the items. For abrasion resistance, they are unmatched; but there are many applications where these blacks are used because they contribute other desirable properties, such as high thermal conductivity, high electrical conductivity, and good overall curing characteristics.

Silicas

Mr. Wolf first pointed out that the reinforcing silicas have in the last few years opened up a new frontier in rubber chemistry since the first precipitated, fine particle size, amorphous silica became commercially available. He presented a comparison of some of the properties of HAF black and Hi-Sil 233 which showed that the specific gravity of the latter was very close to the that of the former; average particle size was about the same, surface area was higher; pH was somewhat less; and ash content was obviously higher.

Reinforcing silica is easily mixed in rubber, and dispersion of the pigment is excellent. Mixing is best done in the Banbury, but if the two-roll mill is used, certain precautions should be observed to maintain maximum physical properties of the vulcanizate. Since reinforcing silicas stiffen rubber compounds to a considerable extent, the effect of softeners is of importance. The best softeners for silica stocks are those of vegetable origin, and petroleum based materials appear to be of little value.

Reinforcing silicas are adsorptive, and in natural rubber compounds it is necessary to use more than a normal amount of accelerator or else employ activators. Any nonstaining antioxidant may be used except where a dead white is desired. In the latter case more care must be exercised because reactions occur between reinforcing silicas and certain antioxidants which produce tints that are very faint, but noticeable.

Several points should be kept in mind in compounding SBR with reinforcing silica, it was said. Accelerator level required is higher; the use of coumarone-indene resin helps bring out the best tensile and tear properties; and although additional fatty acid is not required with regular SBR compounds loaded with silica when cold SBR is used, silica loadings make the stock sticky unless two or three parts of stearic acid are used as a lubricant.

Properties imparted to both hot and cold SBR and nitrile, NBR, stocks were presented. In neoprene stocks, the silicas were described as excellent loading materials. Use of about 1.0 part of Permalux (di-o-tolylguanidine salt of dicatechol borate) is usually desirable in Hi-Sil 233 loaded neoprene to speed up the rate of cure, it was added.

Hi-Sil 233 is particularly useful for producing non-black butyl rubber, IIR, compounds. Such stocks are sticky, but this difficulty can be eliminated by the use of an ester plasticizer such as KP-140 (tributoxy ethyl phosphate). Compounding of colored butyl compounds was next described.

Compounds containing mixtures of reinforcing carbon black and reinforcing silica were shown to have somewhat decreased modulus and hardness and increased elongation and slightly increased tensile and tear resistance, when compared with all-black stocks. Abrasion resistance of such stocks appears to be higher than would be expected from a straight-line proportionality relation. Resistance to hand tear is higher than for all-black stocks.

It was the opinion of this speaker that mixtures of reinforcing blacks and reinforcing silicas are worth considerably more study.

Svetlik Discusses SBR before Philadelphia Group

The Philadelphia Rubber Group at its dinner-meeting on April 12 at the Poor Richard Club, Philadelphia, Pa., heard J. F. Svetlik, Phillips Chemical Co., discuss "The Manufacture, Special Features, and Applications of Styrene-Butadiene Copolymers." The meeting was attended by 171 members and guests including B. S. Garvey, Pennsylvania Salt Mfg. Co., and John M. Ball, Midwest Rubber Reclaiming Co., present and a past chairman of the Rubber Division, ACS, respectively.

Group chairman, J. R. Mills, Goodall Rubber Co., presided and announced that the summer golf outing would be held at the Manufacturers' Country Club, Oreland, Pa., on August 16, with R. A. Garrett, Armstrong Cork Co., general chairman for this event. Cash door prizes were won by W. H. Hannaway, Lee Rubber & Tire Corp.; H. E. Selby, C. P. Hall Co.; and R. A. Stengard, E. I. du Pont de Nemours & Co., Inc.

In reviewing the manufacture of styrene-butadiene rubbers, SBR, Mr. Svetlik referred to the two principal grades, that is hot rubber made at 50° C. (122° F.) and cold rubber made at 5° C. (41° F.), and added that as the polymerization temperature is decreased, the quality of the rubber is improved. Principal ingredients which influence the physical properties of the rubber are the bd/sty ratio, type of soap used for emulsification of the monomer, and quantity of mercaptan used for regulating the Mooney viscosity of the final product. The function and types of shortstops and antioxidants were next described, then the unpigmented rubbers, carbon black masterbatches, oil masterbatches, and oil-black masterbatches made at the various copolymer plants were then discussed, with special reference to their use in the compounding of end-products.

The superior aging resistance of synthetic rubbers to natural rubber, because of the former's reduced susceptibility to chain scission, and their superior abrasion resistance in passenger-car tire tread service, especially under more severe conditions of service, were emphasized. Better electrical resistivity and thermal conductivity of synthetic rubbers, as compared to those of natural rubber, were also mentioned.

Information on cold SBR in comparison with cold oil-extended SBR for general and specific end-products and a review of the general- and special-purpose SBR's with regard to properties and applications was included in Mr. Svetlik's talk.

Great emphasis is currently being placed on improving the color of unpigmented elastomers for use in light-colored goods since antioxidants which are non-discoloring and non-staining generally impart relatively poor resistance to oxidation. The industry is searching diligently for new antioxidants possessing the above attributes which will offer greater protection against aging. In oil-masterbatches used in light-colored goods various oils are being evaluated. The oil must be stable in color, stable to oxidation, must not stain or discolor, and must be soluble in the rubber so that it will not bleed and thereby destroy building tack.

With continuing research it is certain that polymerization scientists will develop improved polymers by new techniques now under investigation. What tomorrow holds no one can foretell, but the future looks rosy, Mr. Svetlik said in conclusion.

Magnetic Elastomers, Urethanes, and Russia Discussed

The spring meeting of the New York Rubber Group was held at the Henry Hudson Hotel, New York, N. Y., March 22. An afternoon technical program was presented consisting of a talk and demonstration on "Magnetic Elastomers for Telephone Answering Sets," by Henry Peters, of Bell Telephone Laboratories, and a talk entitled, "Urethane Elastomers," by W. G. Ogden, E. I. du Pont de Nemours & Co., Inc.

At the dinner-meeting a sound moving-picture entitled, "Russian Close-Ups," was shown and explained by Raymond Bill, president, Bill Brothers Publishing Corp., who was one of a group of businessmen visiting Russia in the Fall of 1956 when the moving picture was taken. RUBBER WORLD and *Plastics Technology* are two of the Bill Brothers publications. Bobby Hackett's Dixieland Sextette entertained during dinner, and door prizes were distributed.

H. J. Due, St. Joseph Lead Co., chairman of the Group, presided at the afternoon technical session and the dinner-meeting. C. V. Lundberg, Bell Labs, Group vice chairman, discussed the activities planned for the Group during the year. As a result of a questionnaire circulated among the members, it was decided to continue the regular Christmas party instead of replacing it with a dinner-dance. Also, since approximately 250 members and non-members are interested in both a course in basic and in advanced elastomer technology, the basic course will be planned for the Fall of 1957 and the advanced course in the Spring of 1958.

Magnetic Elastomers

In the field of sound recordings, many present-day applications make use of plastic tapes coated with magnetic red iron oxide, it was said. In the recently developed Bell System recording and telephone answering devices, the iron oxide exists as a dispersion in an elastomeric matrix. During the operation of the equipment, a metal recording head glides over the surface of a magnetic sleeve. An elastomer is preferable for this application because it permits the head to indent the surface of the sleeve, thereby maintaining better head contact.

Many elastomers, such as neoprene, butyl, nitrile, and chlorosulfonated polyethylene rubbers and blends of the latter with other rubbers were evaluated for this purpose. All of them, with the exception of the chlorosulfonated polyethylene (Hypalon[1]), were unsatisfactory from the standpoint of wear and frictional noise. The use of wax, graphite, and silicone oil on the surface of the magnetic elastomers other than Hypalon provides temporary relief, but is not a permanent answer.

The scorch characteristics of the highly loaded Hypalon compounds are relatively poor, especially the lead compounds. Although compounds containing magnesium compounds process better, the lead compounds are preferred because of their lesser sensitivity to conditions of high humidity.

The physical, chemical, and magnetic properties of many compounds were described, and the output signal, signal-to-noise ratio, and frequency response were shown to be a function of the volume loading and dispersion of the oxide.

Urethane Elastomers

From the standpoint of basic chemistry, urethane elastomers are radical departures from the classical addition types of elastomeric materials, it was pointed out. Urethane elastomers are condensation products of diisocyanates and diols and may be prepared in a great number of variations.

Du Pont has under development a polyurethane elastomer, Adiprene C,[1] which can be cured with sulfur and conventional accelerators. Earlier polyurethane elastomers, including Adiprene B,[1] Du Pont's first polyurethane elastomer, are cross-linked by means of diisocyanates, and this vulcanization system presents difficulties that have been overcome with the sulfur-cure type.

Adiprene C can be compounded, processed, and cured with little deviation from methods in common use for natural and SBR rubbers. In contrast to the self-reinforcing polyurethanes such as Adiprene B, the new elastomer has relatively low gum strength, but is strongly reinforced by fillers, particularly carbon blacks.

Adiprene C vulcanizates have a good balance of properties, including outstanding abrasion resistance together with resistance to crystallization, good heat aging, and also resistance to ozone, oxygen, and oil.

[1] Trade mark of Du Pont company.

NBS' Leo Wall Honored

Leo A. Wall, a chemist at the National Bureau of Standards, has been presented with the Arthur S. Flemming Award, made annually to ten outstanding young men in government by the District of Columbia Junior Chamber of Commerce.

Recognized as one of the world's outstanding authorities in the field of polymerization chemistry, Dr. Wall has contributed fundamental theories to the field which have aided the rubber and plastics industries in the development of new types of materials having unusual chemical and physical properties.

The Flemming Award is Dr. Wall's third honor within the past six years. In 1951, he received a Fulbright Fellowship for a year's study in Paris. In 1955, he was awarded the Department of Commerce Silver Medal for his work in the field of polymer chemistry.

Dr. Wall joined the NBS staff in 1945 after earning his Ph.D. in chemistry at Catholic University. He is currently a member of the Washington Academy of Sciences, Phi Beta Kappa, Sigma Xi, and Alpha Chi Sigma, and is on the membership committee of the Polymer Division of the American Chemical Society.

Leo A. Wall

P.Q. Group Hears Taylor

The Quebec Rubber & Plastics Group, meeting March 21 at the Queens Hotel, Montreal, P.Q., Canada, heard D. M. Taylor, president of Organic Laboratories, discuss "The Role of the Consultant in the Plastics Industry."

Defining the consultant as "one who can make a dollar for his client more cheaply than the client can do himself," Mr. Taylor said that much of the consultant's work is devoted to directing available information into the hands of those who are in a position to use it. He stressed however, that the important role of the plastics consultant is that of taking on development jobs which the client is not in a position to do.

Discussing a recent trip through Germany, the speaker described the progress being made there in studying the effect of blends of the new polypropylene and various rubbers, indicating that a new group of important materials will spring from the investigation.

Ontario Radiation Talk

"Use of Radiation in the Rubber Industry" was the subject of a talk given by M. T. Neill, sales development manager, Isotope Products, Ltd., Oakville, Ont., Canada, at the April 9 meeting of the Ontario Rubber Section, CIC, at the Pickfair Restaurant, Toronto, Ont.

The speaker described the development and application of his company's primary product, the beta ray gage. Using slides, he discussed various installations of the device and outlined the types of atomic radiation in use.

The following officers were elected for the 1957-58 term: chairman, Wray A. Cline, Canadian General-Tower, Ltd.; vice chairman, Carl M. Croakman, Columbian Carbon (Canada), Ltd.; secretary, R. R. Tartaglia, B. F. Goodrich, Canada, Ltd.; and treasurer, Des Seymour, Wooster Rubber (Canada), Ltd.

NEWS of the MONTH

Washington Report and National News Summary

. . . A huge alcohol butadiene manufacturing program, requiring government subsidy and operation, has been urged on Congress by the Welsh Commission on Increased Industrial Use of Agricultural Products. The Commission, however, could not unanimously recommend the program.

. . . Elimination of the essential services of the Commerce Department's Business and Defense Services Administration, including those for the rubber industry, will end June 30, if the House Appropriations Committee budget cut is not restored.

. . . The National Tire Dealers & Retreaders Association, in Congressional hearings, opposed The Rubber Manufacturers Association, Inc., position on the amendment to the Robinson-Patman Act which would end the so-called "good faith" defense to a suit charging a seller with price discrimination.

. . . New management-labor contracts were signed in March and April by Seiberling Rubber Co., United States Rubber Co., and B. F. Goodrich Co., with the United Rubber Workers of America, AFL-CIO. The URWA's goals for 1957 have been announced.

Washington Report

By ROBERT E. L. ADAMSON

Alcohol Butadiene from Farm Surpluses Program Urged on Congress by Welsh Commission

A huge alcohol butadiene manufacturing program, based on full reactivation of the government-owned plant at Louisville, Ky., and one formerly owned by the government at Kobuta, Pa., was urged on Congress in April by the President's Bipartisan Commission on Increased Industrial Use of Agricultural Products, headed by J. Leroy Welsh. Adoption of the proposal would bring revitalization of not only Louisville and Kobuta—both now idle—but also some 10 privately owned alcohol plants in idle status.

Submission of the broad plan all but sank hopes of the Federal Facilities Corp. to sell the Louisville plant this year. There appeared little likelihood Congress would approve a Louisville Sales Program until it has given close study to the Welsh Commission plan for government-controlled operation of the plant. How long this would take is anybody's guess, but time is definitely against completion of the study in time to permit FFC to negotiate a sale and have it OK'd by Congress before adjournment this summer.

Surplus Grain Butadiene

The Welsh program, though complicated and iffy, centers on two major propositions: (1) the manufacture of millions of gallons of alcohol annually from surplus grain, chiefly corn and wheat; and (2) the production of butadiene from this alcohol for marketing domestically or abroad to the manufacturers of synthetic rubber, paint, and plastics. The basic ingredient, alcohol, would be produced in idle industrial alcohol facilities in the East and the Midwest. These plants, capable of producing almost 200 million gallons of 95% alcohol a year, would send their output to Louisville and Kobuta for conversion to almost 180,000 tons of butadiene annually.

The Commission estimated it would take almost 68 million bushels of surplus grain to carry forward the program at this rate. The opportunity to unload surpluses of this dimension quickly caught the attention of farm Senators Carl T. Curtis, Nebraska Republican, and Paul Douglas, Illinois Democrat, who co-sponsored a bill to authorize the Welsh Commission program.

In a letter to Senate Banking Chairman J. William Fulbright, Welsh summed up the Commission's feeling on a "grand-scale" alcohol butadiene program:

"The Commission is aware that an alcohol butadiene operation could provide an important outlet for the disposal of grain surpluses. Among the considerations involved, besides disposal, are possible future outlets for grain, the need of cost-finding experiments, and some associated opportunities for research.

"From the facts that have come to the Commission's attention the alcohol butadiene process cannot at present compete economically with the present production from petroleum. What the long-time situation could be remains for further research and experiment to determine. The cost of an alcohol butadiene program probably would be lower than some of the current grain disposal programs.

"The Commission cannot anticipate the results from an experimental cost-finding operation. Should Congress, by authorizing a cost-finding period of alcohol butadiene operation, approve an effort to appraise the eventual economics involved, the matter could thus be determined. The Commission, of course, cannot foresee what decision Congress may make."

A Subsidized Operation

In a detailed explanation of the plan the Commission emphasized that it would not require government funding of new plants. The key, it was made clear, was to come up with "sufficient" incentives—

J. Leroy Welsh

Chase, Ltd., Photo

J. Leroy Welsh, of the University of Nebraska, presented Congress in April with the interim report of his Bipartisan Commission on Increased Industrial Use of Agricultural Products. Mr. Welsh had outlined earlier to the Senate Banking Committee the Commission's thoughts on an ambitious alcohol butadiene program to rid the nation of its huge surpluses of grain.

Welsh and his four fellow members of the Commission subsequently failed, however, to give the plan a whole-hearted endorsement, suggesting instead that the government sponsor a "vigorous research program to determine costs and discover outlets" for grain through the manufacture of alcohol and/or butadiene. The Commission, which was specifically charged by Congress to report upon the use of agricultural products "in the manufacture of rubber, industrial alcohol, motor fuels, plastics, and other products," reported to Congress that it was "unable to agree upon a specific recommendation for activation of ten existing alcohol and two butadiene plants."

Nevertheless, by the very fact that at least one or two members of the Commission favored a large-scale experimental program utilizing all 12 plants appeared to be reason enough for full exploration of the proposal by Congress. Since one of the butadiene plants covered by the scheme is the government-owned facility at Louisville, Ky., there was considerable doubt that Congress would OK sale of Louisville until it was satisfied it would be feasible to retain the plant for the surplus grain proposal.

making government grain available at prices low enough to permit sale of the finished butadiene in competition with petroleum butadiene. Secondly, the government would have to show the way, eventually, on cutting production costs to competitive levels even when the initial grain costs were unsubsidized. By a full-scale experimental program, the Commission suggested, the government would have to demonstrate that butadiene could be economically produced from grain, which is purchased in a free, competitive market.

In the meantime, the Commission freely admitted, grain from the Commodity Credit Corp.'s huge stockpile "would have to be supplied to the industrial alcohol plants at considerably under the going market for grains," to permit it to compete with alcohol made from petroleum or natural gas. On the controversial question of how to dispose of the butadiene without disturbing the private economy, the Commission suggested that the petroleum industry could go on supplying an estimated 71% of the country's demand for industrial alcohol and still leave a market for 98 million bushels of surplus grain annually. Some 30 million bushels would go to make alcohol which, until recently, was manufactured from Cuban molasses; another 68 million would go to produce butadiene for the expanding synthetic rubber, plastics, and paint markets.

"It should be pointed out," the Commission noted at this point, "that the Department of Defense buys large quantities of industrial alcohol directly and through various suppliers of products. A method might be developed, if it became necessary, whereby alcohol from grain could be supplied to the Defense Department and/or its suppliers at prices competitive with the prices now being paid, and the grain be supplied from the government stockpile to the industrial alcohol producers. . . . Consideration might also be given to the matter of stockpiling of industrial alcohol."

The Commission said it had widely varying estimates of producing alcohol from different grades of corn. They ran from 26-47¢ a gallon of 190-proof alcohol from 50¢-per bushel corn, to 50-75¢ for corn selling at $1.25 per bushel. To be competitive with alcohol from butane or butylene, also basic butadiene materials, grain alcohol would have to be delivered to butadiene plants as 20-25¢ per gallon, the Commission estimated. But by utilizing by-products now destroyed, the Commission added, it could be feasible to operate with alcohol costing as much as 30¢ per gallon.

"It would seem that accurate costs on an overall program can be obtained only by carrying on an experimental program for a year or two, using all of the capacity of the (ten) idle industrial fermentation alcohol plants, and the alcohol butadiene units at Louisville and Kobuta.

"During the (World War II) years, the alcohol fermentation industry produced alcohol for butadiene (for the synthetic rubber program) without regard to costs or study of by-products. The Commission feels that a vigorous research program towards solving the problem of removing the starch from cereal grain prior to fermentation of industrial alcohol (or prior to removal of the starch for other industrial uses) will upgrade the protein from the grain into human food.

"It seems possible that by thus increasing the recovering value of the protein the production of industrial alcohol from the remaining starch would become a by-product, and the cost lowered sufficiently to compete with petroleum products in the expanding synthetic rubber, paint, and plastic markets. Manufacture of alcohol and butadiene on a full-scale basis with careful study and analysis of results is necessary to determine the future economic position of grain in this industrial use.

"(We) believe that if an alcohol butadiene program is adopted, all plants—including those owned by the government, whether for the making of alcohol or butadiene—should be operated by private industry."

The Commission's presentation was rounded out by a cost comparison of the new program with the programs already being used to dispose of surplus grain. It was conceded quickly that the government got far more for the 60% of its grain surpluses sold for cash in recent years than it could possibly get from an alcohol butadiene program. As for the rest, however—that shipped overseas for foreign currency, for relief, and for barter— the Commission said, the government's return was so low that it would probably be better off financially converting the surpluses to alcohol.

"A comparison of the costs of the disposal of surplus grains for foreign currency and the cost of diverting grain for conversion to alcohol," the Commission said with tongue in cheek, "indicates that the latter program might be less costly."

Petroleum Opposition Likely

At any rate, even the bare possibility of a program to cut down overbearing farm surpluses appeared more than enough to interest the powerful farm bloc in blocking sale of the Louisville plant, pending a comprehensive study, complete with public hearings, of the Welsh Commission plan. The prospect of competition from alcohol and butadiene manufactured from cheap, government-owned grain, however, appeared just as likely to stir strong obstructionist tendencies in Congress's powerful oil bloc.

Economy Move by Congress Proposes Ending Commerce BDSA Divisions, Including Rubber

The razor-sharp ax of the House Appropriations Committee fell in April on the 25 industry divisions of the Business & Defense Services Administration. Caught up in a riptide of economy was BDSA's Chemical & Rubber Division, an advisor to both industry and government via its statistics-gathering services for mobilization preparedness. The Division was tentatively killed when the House ratified the Appropriations Committee's decision to cut fiscal year 1958 funds for the BDSA industry units out of the appropriations bill for the Commerce Department.

As RUBBER WORLD went to press, the initial shock of Commerce, Defense, and Office of Defense Mobilization officials was giving way to growing confidence that the Senate would restore the $3,500,000 cut to permit the 25 industry units to carry on through June 30, 1958. If, however, a substantial part of the amount is not restored by the Senate—and made to stick when Senate and House get together to iron out their differences—the Chemical & Rubber Division and its 24 counterparts will go out of business on June 30 of this year.

BDSA Functions

The Division's parent agency, Business & Defense Services Administration (BDSA), is the key federal unit under the complicated and far-reaching preparedness program. As such, it reports directly to new Defense Mobilizer Gordon Gray on this nation's ability to supply thousands of commodities during a period of war, including rubber, and advises him on the amount of reliance he can give to rubber and other inventories of the Federal Government. In exercising these functions, BDSA collects and distributes statistics on production, consumption, and stocks of synthetic rubber (SBR, neoprene, nitrile, and butyl and latices), natural dry and latex rubber, and reclaimed rubber.

As BDSA was quick to point out in the after-shock of the House action, the records on rubber and other commodities are relied upon by government agencies for use in rubber policy guidance (ODM, Defense Department, the General Services Administration, State Department, the Tariff Commission, among others); are used widely by producers, traders, and consumers of rubber materials, and by companies in other fields which serve or supply the rubber industry—oil, chemicals, transportation, banking, autos, advertising, etc.

As direct subsidiary agents of ODM and the Defense Department, BDSA and its industry divisions carry a heavy responsibility in estimating the ability of the economy to recoil sharply from an enemy attack and in providing plans for it to proceed with building and resuming production at maximum efficiency. In the case of rubber, their day-to-day work includes periodic estimates of mobilization requirements—civilian and military—for rubber and rubber products, periodic review of estimates of tonnage requirements for the national rubber stockpile (generally enough to carry the country through a five-year conflict), expedition of orders for rubber products required by the military and Atomic Energy Commission, the enlistment of industry personnel and cooperation in company defense preparedness measures, and assignments of industry officials to government positions in an emergency.

Defense Mobilizer Gray, obviously exercised about the threat to the preparedness program posed by possible loss of the 25 industry divisions, said these duties would have to be performed within the government regardless of the Senate's action. The feeling among close observers was that transfer of the functions to the Defense Department or ODM would leave industry out in the cold. Industry gets a substantial share of the up-to-date figures prepared for the mobilization program by BDSA, but might find it difficult to get the same data if the function is transferred away from the business-minded Commerce Department.

BDSA Rubber Branch

Rubber has been represented by a special unit in the department since 1921, when the Commodity Division system was initiated by Herbert Hoover as Secretary of Commerce. The Rubber Branch is presently a part of the Chemical & Rubber Division of BDSA, under an assistant director for rubber, Everett G. Holt. The Rubber Branch represents the nucleus of the organization required to assume federal authority over the rubber industry in case of war, when the statistics on rubber consumption by companies would presumably again become the basis of allocations of materials.

The 10-man staff of the Rubber Branch, though chiefly concerned with gathering, preparing, and disseminating statistics, also serves the industry through contacts by letter, personal interviews, and publication of articles of general interest in the monthly Chemical and Rubber Report and elsewhere. Forty-year-man Holt, looking toward retirement some time this year, has a nine-man staff which includes three working on statistics exclusively and three analysts: rubber materials; tires, tubes, and allied products; and non-tire rubber products. He and his colleagues fear that if the rubber and other statistical services of BDSA are discontinued even briefly, key personnel will be dispersed, and their services could not again be restored with equal accuracy, completeness, and feeling for their particular commodities.

False Economy?

The rubber unit has a budget of less than $75,000 a year. Compared to excise taxes paid into the federal treasury during 1956—$204,000,000—this is an insignificant amount. Compared to all taxes stemming from rubber activity in this country, it is microscopic. At month-end, whether the industry was going to get statistical and advisory help from the Rubber Branch after June 30 appeared to depend on (1) the Administration's ability to reverse the House action in the Senate; and (2) the extent of industry outcry for restoration of the fiscal 1958 funds.

NTDRA Supports Patman-Kefauver Amendment To Robinson-Patman Act; Disputes RMA Stand

The National Tire Dealers & Retreaders Association got in the last word during April on the controversial price discrimination bill opposed strongly by The Rubber Manufacturers Association, Inc. NTDRA is just as strongly in favor of the bill, which would virtually abolish the so-called "good faith" defense to a suit charging a seller with price discrimination.

In the rubber industry the defense permits rubber manufacturer "A," for example, to lower his price to one dealer in the New York area (leaving it at the same level to other dealers) if the dealer has been offered a lower price by rubber manufacturer "B," who seeks to invade the market for the first time. By meeting this competition in good faith, manufacturer "A" is permitted to discriminate between his New York area dealers, though the Robinson-Patman Act declares price discrimination illegal.

One of the last witnesses in a long series of hearings before the Senate Anti-Monopoly subcommittee, W. W. Marsh, executive secretary of the NTDRA, complained of much the same competitive injury as dealer spokesmen from the gasoline and other industries. Basically, the complaint is this: When a manufacturer or distributor, though acting in good faith to meet competition, lowers his price to only one or a few dealers in the same competitive area, he wreaks havoc on the other dealers.

The basic manufacturers' argument (covered in the April issue of RUBBER WORLD) is that this type of leeway is the only method of meeting cut-throat competition. Though manufacturers have other, equally important arguments, they remind anyone who will listen that the good-faith language of the Robinson-Patman Act was specifically inserted in the Act to stop the former practice of invading a new market with non-profit prices, killing off weaker companies already in the market, then boosting prices to any level because there is no longer any competition.

Pro's and Con's on S. 11

At the end of weeks of public hearings, the Senate anti-monopoly unit had before it one of the most confused hearing records the Capitol has seen for a long time. The committee faced a situation which was hardly the cut and dried picture of big business *versus* small business. The record which the committee took

under consideration was replete with earnest, sensible argument on both sides of the issue from both segments of the economy. Less than a year ago, the House passed the very legislation in controversy by the almost unanimous margin of 393-3. Yet by the end of the last session, the very small business people the bill was supposed to help—chiefly, an oil industry group championed by the National Oil Jobbers Council—had roused the opposition sufficiently to prevent the bill from even reaching the Senate floor for a vote.

This rousing response to a near-cancellation of the good-faith defense carried over into the present session of Congress, picking up adherents by the score from both small and big business. In January, the odds in favor of Congressional approval of good-faith repeal were so heavily weighted against the opponents it would have been difficult to find anyone with whom to bet. Now, to most observers here, the chances of enactment of the bill are less than 50-50.

Nevertheless the proponents had much to say in justification of some change in the present law. First, they insist that a lowered price to one dealer can be extended to all dealers in the same competitive area without substantially harming the competitive position of the seller. The rubber manufacturers and their allies say, first, that it is almost impossible to define a competitive area—a city in some cases, a state or group of states, or even nation-wide—and, second, that fear of possible treble damage suits would force a seller to lower his price to all at staggering losses or to none at a loss of his customers.

NTDRA Arguments

To their complaints that the repeal bill (S. 11) would kill the price flexibility so typical of the rubber industry, Mr. Marsh replied:

"Looking at it from the standpoint of the economics of competitive price, the argument runs the other way. Economists mean by price flexibility the sensitivity of prices in a market to supply and demand conditions. S. 11 would require market-wide price adjustments to meet competition. This is price flexibility. On the other hand, without S. 11, a manufacturer can lower price selectively; he can practice price discrimination. This means that he holds prices rigid to most of his customers and lowers prices to a favored few. This is limited, selective flexibility in a framework of rigid prices."

Marsh, wielding his cudgel with bluntness, accused RMA and other opponents of S. 11 of seeking "discretion to manipulate their prices in a given market." Their definition of flexibility, he argued, was the freedom to discriminate among their customers.

". . . the RMA," he said, "cites a hypothetical example (of what it would face if S. 11 were approved). A rubber manufacturer named Smith has five customers in a particular market. Jones, a competitor, attempts to lure away Smith's best customer with a lower, lawful price. Under S. 11, Smith would face these choices: (1) he could meet the lower price selectively and risk damages for his discriminatory practice; (2) he could lower his price to all five customers and possibly face ruin thereby; and (3) he could simply let his competitor take his best customer.

"The RMA assumes as a practical matter that Smith would let his customer go if S. 11 were passed into law. Smith would not risk prosecution for price discrimination, nor ruin by reducing his prices to all five customers.

"This is not a convincing example. The RMA said . . . that most of the industry's products are made of like materials by similar processes and manufacturing methods. Direct production costs per unit must therefore be fairly uniform, unless Jones' lower price reflects some new cost-saving method, or a new product which is a substitute for Smith's product.

"Let us first accept the RMA assumption of like materials, processes, and therefore direct costs. If meeting Jones' lower price would ruin Smith, then by the same token, Jones must be indulging in self-destruction. This is simply improbable. On the other hand, if Jones' lower price reflects a new and more efficient production method or a substitute product, Smith faces ruin whether he meets the lower price or not.

"To avoid ruin, he must adopt the more efficient process or produce the new product.

"S. 11 has no bearing on this, except perhaps to speed Smith on the way toward modernization of methods or products. This is what flexible price competition achieves. Price discrimination can slow up this process."

New Labor Contracts Signed; URWA Sets 1957 Goals

Management-labor negotiations and activities in the rubber industry were more than usually prominent in the news in late March and early April. Contract negotiations were in progress between United States Rubber Co., The B. F. Goodrich Co., and Seiberling Rubber Co., and the United Rubber Workers of America, AFL-CIO, and the URWA held a meeting of its international policy committee in Philadelphia in late March to determine the economic program it would attempt to achieve for its members in 1957.

U. S. Rubber Agreement

United States Rubber announced April 9 that it had reached agreement with the URWA on a new two-year company-wide contract which included 20 improvements highlighted by three weeks' vacation for employes with 11 years of service and four weeks' vacation for employes with 25 years of service.

The contract also provided for funeral pay up to a maximum of three days in the event of the death of a member of the immediate family, and a maximum of two weeks' military reserve make-up pay if an employe is called to temporary active duty.

Wages were discussed, but complete negotiation in this field was deferred until a later date. The new contract contains a 60-day wage reopening clause.

Nineten plants in 11 states employing more than 30,000 workers are covered by the new agreemnt, which was reached after seven weeks of negotiations.

Goodrich Contract

The B. F. Goodrich Co. signed a new two-year contract with the URWA in mid-April after five weeks of negotiations, during two of which the 15,000 workers in nine Goodrich plants were on strike. In addition, the synthetic rubber plant of Goodrich-Gulf Chemicals, Inc., at Port Neches, Tex., was forced to close down on April 9 because of this Goodrich strike.

The new Goodrich contract, which runs until April 15, 1959, provides three weeks' vacation for employes with 11 years' service and four weeks' vacation for those with 25 years service. Make-up pay for a worker called to two weeks military service a year and three days off with pay for death in the worker's immediate family were also part of this new contract.

Other items covered in the contract included a revised piecework rate-setting system, company-paid grievance committee time based on a special formula, payment by the company for repair or replacement of eyeglasses damaged on the job under certain conditions, etc.

Seiberling Contract

A new master contract agreed upon in late March between Seiberling Rubber Co. and the URWA was similar to the U. S. Rubber and Goodrich settlements and may have set the pattern for the latter agreements. The three-week vacation after 11 years and four-week vacation after 25 years, the make-up pay for military duty, and the paid time for funeral attendance were all of the same nature as in the other two new contracts.

The Seiberling agreement, which affects all hourly and production employes in the company's Barberton and Carey, O., plants, expires on May 1, 1959, and was signed without a union strike vote, an action often taken during contract negotiations, it was said.

URWA 1957 Goals

Some objectives that URWA will attempt to achieve for its members in 1957, as decided at the meeting of its policy committee on March 22 and 23, were as follows: (1) a substantial wage increase; (2) elimination of wage differentials between plants; (3) increased participation in the present supplemental unemployment benefit program; (4) extension and improvement of pension and insurance programs; (5) negotiation of provisions to afford additional protection against wage losses arising out of occupational injuries or disease; (6) increased efforts to maintain, improve, and extend existing fringe benefits.

Wages were not an issue in any of the new contract negotiations and settlements which have been taking place since early this year. The union saves the wage issue for separate negotiations later.

Industry News

Five Research Men Optimistically View Today and Tomorrow's Synthetic Rubber Industry

Five of the synthetic rubber industry's leading researchers have taken a hard look at the industry's current stage of development and ventured to predict the directions of future expansion.

The prognostications were voiced in a special four-article report published in the March, 1957, issue of *Petroleum Refiner,* a monthly trade magazine on the petroleum industry.

The authors, all of whom expressed their confidence in the continued growth of the industry, were Clayton F. Ruebensaal, director of commercial planning for Texas-U. S. Chemical Co., New York, N. Y.; Harry L. Fisher, past president of the American Chemical Society and retired professor of chemical engineering at the University of Southern California; John L. Ernst and E. Arundale, Enjay Laboratories, Linden, N. J.; and Johan Bjorksten, president of Bjorksten Research Laboratories for Industry, Inc., Madison, Wis.

Writing on **"Trends in Synthetic Rubber Growth,"** Mr. Ruebensaal outlined the productive position of the industry while under government ownership, at the end of the first 12 months of private ownership, the industry's position today, and its expected position in the 1960's.

New domestic capacity, resulting largely from the first private capital investments for new equipment in the butadiene-styrene segment of the industry, brought about a 22% expansion from 1.15 million long tons to 1.4 million long tons for all synthetic rubbers in 1956. An increase to 1.6 million long tons is planned for 1957.

The 549,000 short tons of butadiene capacity purchased by industry were increased to 650,000 short tons by the end of 1956. The total by mid-1958 will approximate 1.1 million short tons. Butyl, also on the upswing, is expected to double its production capacity by the early 1960's

According to Mr. Ruebensaal, the most obvious and important of all trends in the synthetic rubber industry is the increased use of synthetic over natural rubber. He cited experts as putting the ratio of synthetic to natural rubber at between 65 and 75% by 1960.

Trends in the SBR field were said to be an increasing preference for cold rubbers over hot, gradually increasing usage of oil masterbatch rubbers, and decreasing percentage usage of the carbon-black masterbatch types.

Synthetic rubbers will continue to improve in color and stability, and they will be made more versatile, with improved and faster curing techniques, gradually winning back some of their markets from plastics and developing new markets both in combination with and in competition with plastic materials.

A final trend mentioned by Mr. Ruebensaal was the continued growth of the non-tire segment of the rubber industry, particularly in the broad field of combinations of elastomers and fibers utilizing increasing amounts of new materials in new end uses.

"Compare Today's Synthetic Rubbers," the subject of Dr. Fisher's article, discussed the characteristics of 12 types of synthetic rubber, how they are made, how they differ from each other, and in what functions they perform the best.

These 12 types were styrene-butadiene rubber, synthetic natural, neoprene, nitrile, butyl, silicone, polysulfide, polyurethane, carboxylic, polyacrylate elastomers, chloro-sulfonated polyethylene, and fluoroethylene elastomers.

Concerning the polyurethane rubbers, which were discovered in Germany during World War II, Dr. Fisher described their advantages, preparation, and uses, and affirmed his belief in their future growth. Experimental tires made with polyurethane treads have shown mileage of more than 50,000 and up to almost 100,000 miles.

Focusing on one of these 12 synthetic rubbers, butyl, Mr. Ernst and Mr. Arundale, in their article, **"Take a Look at Butyl Rubber,"** summarized the rubber's techniques of production, properties, and its applications.

Butyl rubber represents a second-stage conversion of the rapidly growing list of petrochemical raw materials. Polymers of this type are produced in two plants in the United States and are marketed by Enjay Co. A plant in Canada operated by Polymer Corp. is also producing butyl.

The capacity of these plants is 116,000 long tons a year. In addition, a new 20,000-t.a plant is being built in France. A 30,000-ton-a-year plant is being constructed in the U. S. by Petroleum Chemicals, Inc.

Mr. Bjorksten, in his article, **"Future Fields for Elastomers,"** said that the increased future use of elastomers are assured because they permit both a saving in time and in speed of fabrication in a great many operations. This will permit the cutting of costs where they are most likely to rise, in human labor.

In the building industry, the advent of elastomeric wall panels of high strength, lightness, and high insulating qualities, would open attractive vistas. Building mistakes could be corrected. In playrooms, elastomeric walls could have obvious advantages. Air-pressure supported buildings could be another rich field for exploitation, according to Mr. Bjorksten.

In the furniture industry, resilient furniture could provide the maximum in self-adjusting comfort with the minimum of cost. Non-flammable elastomers could be attained through the development of phosphorus polymers or fluorinated compounds.

In the food field, elastomeric plastic films of high-temperature resistance and low permeability could prove difficult competition for aluminum foil. An interesting application for the oil industry lies in the use of reinforced elastic tubing as extrudable piping. Elastomeric glass which could withstand temperatures even higher than those usable with the silicone polymers was another possibility laid down.

Reaching far into the future, Mr. Bjorksten saw the possibility of an air pressure-supported structure which could serve as the hull of a sea-going vessel. This would be made of a fluorethylene-type transparent film with virtually no absorption in the ultra-violet range as a protection against weather deterioration.

Reinforcement of this film would be provided by a criss-cross of continuous fibers, spaced about one-half inch apart, between two films, in an adhesive soft enough to permit slippage of the fibers in case of incipient tear. This principle has been fully proved in practice. The hull would be insulated by means of an elastomeric foam sprayed inside.

For oil-tankers carrying loads in one direction only, it would be possible to deflate and fold up such elastomeric tankers on the return trip so as to ship home, for example, nine tankers as cargo on the tenth, saving appreciable fuel and operational expense.

Du Pont Akron Lab Wing

A new wing for its Akron district sales office and laboratory is being built by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., with completion of the project scheduled for the end of the year.

The addition will expand sales and development service to the company's customers in the Akron and Chicago districts. It will include additional laboratory facilities for "Hypalon" and "Hylene," expanded office space for the sales force, and clerical facilities to service both the sales group and the laboratory technical staff.

Wabash Enlarging Plant

An additional 45,000 square feet of production and warehouse space will be added to the existing 15,000 square feet plant at Seymour, Ind., of Wabash Rubber & Plastics Corp., it was announced by H. O. Canfield Co., Bridgeport, Conn., the parent organization.

The new addition will more than double Wabash's production of rubber and plastics items, and the payroll will be increased by 200 people. The company's original building at this location was opened in September of last year.

Nopco Begins Operations at New Urethane Foam Plant

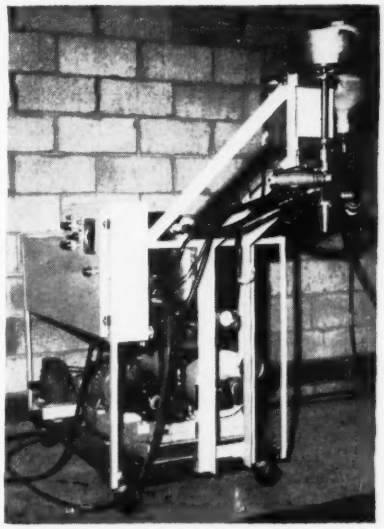
Nopco Chemical Co., Harrison, N. J., has begun operations at its recently completed North Arlington, N. J., plant, said to be the first plant in the East to be devoted solely to research and production of urethane plastic foams.

Ralph Wechsler, president of the industrial chemical producing firm, told guests attending the opening ceremony that demand for urethane foams should rise to between 100 and 300 million pounds a year within the next three years.

The featured exhibit at the new plant was a demonstration of the company's newly developed machine for the assembly-line metering, mixing, and dispensing of pour-in-place urethane foams. Called the Nopcometer, this machine will be leased to customers, with Nopco providing technical assistance in its use.

The unit delivers a predetermined charge of the urethane foam components at any given rate from one pound to 50 pounds a minute. The operation can be made automatic and intermittent. The mixing head can be as much as 20 feet from the metering pumps.

Available in three different designs to handle various pour-in-place systems, the Nopcometer is mounted on wheels for portability. Its approximate weight is 800 pounds. An air supply and a 220-volt, three-phase power source are the only things needed in a plant to operate the machine, according to the company.



Nopco Chemical's Nopcometer

While supplying the mixing units, the company will also provide its two urethane foam formulations. The first is a pour-in-place rigid and semi-rigid foam called Nopco Lockfoam. The second is a flexible foam in slab, sheet, or precut form called Nopcocell. Both types are available in a variety of tailored-to-application formulations.

First Houdry Unit on Tap At Texas Butadiene Plant

The first of two 43,000 tons-a-year Houdry dehydrogenation process units for producing butadiene has been activated at the new $30-million Channelview, Tex., plant of Texas Butadiene & Chemical Corp., the first new butadiene plant to be completed by private industry since World War II.

When the second Houdry unit has been put into operation at an as yet unspecified time, the plant will have a capacity of 86,000 tons of butadiene annually, or, alternatively, 61,000 tons of butadiene a year and about 2,500,000 barrels of aviation-grade alkylate, which it can also produce.

The Houdry dehydrogenation process is a single-step method, employing an alumina-chrome oxide catalyst, which transforms fresh butane, mixed with butane-butene recycle stock from the plant's butadiene recovery section, into butadiene or butenes.

The Houdry process was developed by Houdry Process Corp., Philadelphia, Pa., during World War II as part of the Federal Government's synthetic rubber program. The Channelview plant is the third such plant to use the process. One of these has been dismantled; while the other, with a capacity of 18,000 tons annually, is still in operation at the El Segundo refinery of Standard Oil Co. of California.

The butadiene recovery section at Channelview employs the Phillips furfural extractive distillation process licensed by Phillips Petroleum Co., Bartlesville, Okla.

Rubber and Chemical Firms High in Management Rating

The B. F. Goodrich Co., Akron, O., and Johns-Manville Corp., New York, N. Y. were among the 20 American companies who received top rating among the 410 companies nominated for excellent management during 1956 by the American Institute of Management, New York, N. Y.

Others in the top category (9,000 points in AIM's comparative audit scale) were Eastman Kodak Co., Rochester, N. Y.; General Electric Co., Schenectady, N. Y.; General Motors Corp., Detroit, Mich.; Minnesota Mining & Mfg. Co., St. Paul, Minn.; and Standard Oil Co. (New Jersey), New York, N. Y.

Among those chosen in the second-best category (8,500-9,000 points) were the following: Armstrong Cork Co., Lancaster, Pa.; E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.; The Goodyear Tire & Rubber Co., Akron, O.; Monsanto Chemical Co., St. Louis, Mo.; and Union Carbide & Carbon Corp., New York.

Included in the third-best category (8,000-8,500 points) were: Allied Chemical & Dye Corp., New York; Allis-Chalmers Mfg. Co., West Allis, Wis.; American Viscose Corp., Philadelphia, Pa.; Borden Co., New York; Dow Chemical Co., Midland, Mich.; Hercules Powder Co., Wilmington; Hooker Electrochemical Co., Niagara Falls, N. Y.; The Timken Roller Bearing Co., Canton, O.; United States Rubber Co., New York; and West Virginia Pulp & Paper Co., New York.

The yearly ratings of the Institute are made on the basis of the companies' economic justification, as well as their treatment of shareowners, customers, and the public. The greatest stress, however, is put on evaluations of the executive teams of the companies.

General Tire Outlook

The General Tire & Rubber Co. anticipates that its sales in 1957 will be substantially ahead of sales for 1956, William O'Neil, the company's president and chairman, told an annual meeting of stockholders in Akron, O., April 2.

L. A. McQueen, vice president, reported that sales of passenger-car tires were 37% ahead of sales for the same period a year ago. He said the company's Dual 90 tire has proved to be "our most active sales item in many years." He added that General Tire was moving ahead rapidly in three new areas of business: airplane wheels and brakes, polyurethane, and air springs.

All directors of the company were unanimously reelected.

Reelect Goodyear Officers

All directors of The Goodyear Tire & Rubber Co., Akron, O., including P. W. Litchfield, board chairman, who has completed 51 years of continuous service as a director, were reelected at the annual meeting of shareholders in Akron on April 1. Included also were: E. J. Thomas, president and chief executive officer; R. S. Wilson, P. E. H. Leroy, and R. DeYoung, executive vice presidents; H. L. Hyde, vice president and general counsel; and F. T. Magennis, president of Goodyear International Corp.

At the board meeting following the stockholders', all executive officers of the Goodyear company were reelected.

Canadian Tire Outlook

Future consumer demand for automobile tires in Canada was described as phenomenal by W. B. Flora, vice president of B. F. Goodrich Canada, Ltd., Kitchener, Ont., before the annual meeting of the Canadian Tire Dealers & Retreaders Assn. in Toronto, April 2.

He predicted that car ownership in Canada would rise at a rate of 4.2% each year and said that the need of trucks would increase at an equally fast rate, particularly as further progress is made in the development of Canada's resources.

He urged tire dealers to place increased emphasis on advertising, displays, and sales training for employes.

Sparks Named "Scientific Advisor" by Esso Research

Fabian Bachrach

William J. Sparks

William J. Sparks, co-inventor of butyl rubber, has been appointed by the board of directors of Esso Research & Engineering Co., New York, N. Y., to the new position of scientific advisor. Since 1946 he has been director of the company's chemicals research division.

His new responsibilities will include surveys of scientific activities in industry, government, universities, research institutes, and professional societies, the company said. Dr. Sparks will also recommend research projects and other courses of action applicable to the company, which is the scientific affiliate of Standard Oil Co. (New Jersey). He will be associated with the office of scientific liaison managed by Dr. Cecil L. Brown.

With the company since 1936, Dr. Sparks is given credit, together with Robert M. Thomas, for having invented butyl rubber, which was first announced in 1939. Winner of the 1954 Gold Medal of the American Institute of Chemists, Dr. Sparks holds more than 100 U. S. patents.

Borden Acquires Lawrence

The Lawrence Process Co., Inc., North Andover, Mass., manufacturer and processor of extruded plastic products, has been acquired by the chemical division of Borden Co., New York, N. Y. Terms of the deal were undisclosed.

The acquisition of Lawrence makes Borden the first extruder of vinyl products with both East and West Coast plants, according to Augustine R. Marusi, president of the chemical division. Last year Borden acquired Resin Industries of Santa Barbara, Calif., now known as the Resinite department of Borden's chemical division.

The North Andover firm, employing 130, completed its 46,000-square-foot plant two years ago. It will supplement Santa Barbara's production of Resinite products. Both plants have been using Borden-made resins in their manufacture of plastic products.

Grant C. Ehrlich, manager of Borden's Resinite department, will have responsibility for coordinating operation of the two plastic extrusion plants.

Polymer Business at Peak

Polymer Corp., Ltd., Sarnia, Ont., Canada, has reported that its 1956 production and sales were the highest in its history. Rubber production totaled 268,000,000 pounds, 11% higher than for the year before; while gross income rose 16% to reach $71,500,000.

The company earned a net income of $9,400,000 after provision of $4,800,000 for depreciation and $8,400,000 for income tax. Dividends of $3 a share were paid out of net earnings of $4.73 per share.

Almost $7,000,000 was spent for additions to plant and equipment during 1956, particularly to increase production of the butyl and copolymer plants. A new turbo-generator installation was completed and placed in operation in 1956. Four new rubber types were introduced during the year.

Among the company's plans for the current year is the building of a latex plant, J. D. Barrington, Polymer president, said.

New BFG Chemical Plant

A $5-million plant for the production of specialty organic chemicals, such as antioxidants, for use in the petroleum, rubber, plastics, and other industries will be built by B. F. Goodrich Chemical Co. near Henry, Ill., according to John R. Hoover, president of the Cleveland, O., firm.

Options on a 240-acre tract on the banks of the Illinois River have been secured by the company. Initial plans call for erection of a process building, an office-warehouse-machine shop, and a steam generating plant, to start this month. About 80 people will be employed when the plant starts operations early in 1958.

Railroad-Highway Van Has Goodrich Torsilastic Spring

Use of a Torsilastic spring, a development of B. F. Goodrich Industrial Products Co., Akron, O., has provided the key to the development of a van which can act as a railroad freight car or a highway-bound semi-trailer.

Dubbed Railvan, the vehicle was developed by the Chesapeake & Ohio Railway to take advantage of the inherent low cost of rail haul and the flexibility of the truck for terminal distribution. The combination van is equipped with both rail wheels and highway wheels.

The Torsilastic spring consists of a rubber tube bonded to an inner stationary metal tube and a movable outer metal sleeve. Deflection of the rubber provides the necessary elasticity, since the arms supporting both highway and rail wheels are attached to the outer casing of the Torsilastic spring.

The suspension is designed so that the length of highway and rail arms is easily controlled, assuring the same spring deflection for both highway and rail operation, according to Goodrich. The rail wheels can also be moved to provide clearance between the rail and the tires, which is achieved by hinging the highway arm on the spring.

The stationary elements of the Torsilastic spring are linked through a splined sleeve and an arm to the actuator screw, which is driven through a gear train by an air motor.

Functioning on 90-psi. air-brake pipe pressure, the air motor twists the spring, transferring the Railvan wheels from highway to rail position or *vice versa* in about 30 seconds. A locking device in the motor fixes the suspension system in any position.

A Goodrich technician indicates position of outer casing of Torsilastic spring on Chesapeake & Ohio Railway's new bi-functional Railvan

New Process Styrene Unit

What is termed the world's first and only plant producing styrene by direct recovery of ethylbenzene from gasoline was officially dedicated on April 3 at Big Spring, Tex., in formal ceremonies at which Cosden Petroleum Corp. and Badger Mfg. Co., Cambridge, Mass., were cohosts.

The $3-million plant has an annual capacity of 20 million pounds of styrene. The production of styrene without the synthesis of ethylbenzene was called a major achievement by company representatives. The plant is said to be running with 100% automation.

Production of styrene at the unit starts with a mixed xylene stream. The ethylbenzene is separated in ultrafractionation columns with a critical boiling point differential of four degrees between the stream constituents. After separation, the ethylbenzene is converted to styrene by the utilizing of such processing techniques as dehydrogenation, recovery, and purification.

Foreign Trade Surveyed

United States industry now makes more than two-thirds of the dollar volume of goods it sells abroad in the countries it sells to, according to Edward J. Higgins, assistant general manager of United States Rubber Co.'s international division.

Speaking at the fortieth anniversary convention of the Export Managers Club of New York, April 2, Mr. Higgins said exports from this country amounted to $16 billion last year, but goods manufactured abroad by American-owned subsidiaries added up to $39 billion, for a total of $55 billion worth of foreign business.

American investment abroad today was said to be close to $29 billion. Of the dollar volume of goods U. S. Rubber sells abroad, 76% is made outside of the United States, Mr. Higgins declared.

But he cautioned companies seeking to gain a foothold in international markets to be prepared to become an integrated part of the economy of the countries in which their interests are located.

BFG Electronic Dip Unit Making Surgeon's Gloves

A new electronically controlled dipping unit that has a daily capacity of 12,000 pairs of natural latex surgeon's gloves has been installed at the Riverside, N. J., plant of B. F. Goodrich Industrial Products Co.

The unit provides a uniform time cycle in the dipping process, thus maintaining uniformity of thickness and eliminating microscopic defects which can shorten the effective longevity of these surgeon's gloves.

Temperature, concentration, and specific gravity of the coagulant and of the latex are rigidly controlled throughout the automatic process, it was explained by A. B. Bush, manager of the firm's sundries department, during a press tour of the plant on March 27.

After the gloves are dipped, they are automatically washed, dried and cured, and inspected manually for defects.

The company-designed dipping control system was said to be the only one of its kind in the industry. It will soon be installed at the second continuous-process glove-making machine at the plant, now under semi-automatic operation.

The Riverside plant produces a wide variety of surgeon's, hospital, industrial, and household rubber gloves of both natural and synthetic rubber latex, as well as latex products for hospital equipment manufacturers.

Soon to be commercially produced is a new surgeon's glove said to be softer and stronger, with greater elongation and tear resistance than any other glove on the market, according to Mr. Bush. It will be sold under the trade name Sensitex.

Automatic controlled dipping of latex gloves at BFG Riverside plant

Clarence H. Mingle

Gates Market Director

Clarence H. Mingle, vice president of Gates Rubber Co., Denver, Colo., has been appointed director of marketing for the company. In this newly created position, he will be responsible for the coordination and direction of Gates' automotive, hardware, industrial, export, tire, tread rubber, and private-brand sales divisions. Management of the individual sales divisions will not be altered as a result of the new assignment, the company says.

Mr. Mingle joined Gates in 1923 as a member of the company's shipping department in the Chicago division.

New Elastomer Licensees

Three more foreign companies have been licensed to produce vinyl foam by the Elastomer process. The Girdler Co., Louisville, Ky., owner of the process, reveals. The firms are Oy Finlayson-Forssa AB, Tammerfors, Finland; Nippon Hikaku Kabushiki Kaisha, Tokyo, Japan; and Imperial Chemical Industries, Ltd., Welwyn Garden City, Herts., England.

Developed by Elastomer Chemical Corp., Newark, N. J., the process employs an inert gas rather than a chemical blowing agent to make foamed vinyl. Seven other foreign firms, all in Europe, have been previously licensed.

BWH Sales Shuffles

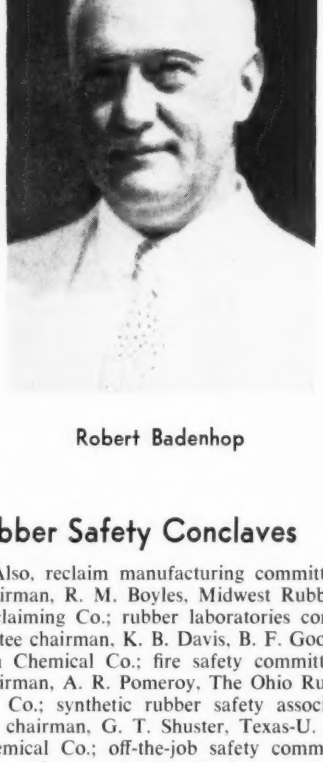
Major staff changes in the sales divisions of Boston Woven Hose & Rubber Co., Boston, Mass., have been announced by R. H. Jackson, director of sales. Charles W. Kline, New England division manager, has assumed the post of western division manager, with headquarters in Los Angeles, Calif. C. E. Hanson, west central division manager, has moved to manager of the south central division and Dallas warehouse. Richard C. Mahony, sales representative in New England, has been advanced to New England division manager, headquartering in Boston.

Badenhop Steps Down as Clearing Association Head

Robert Badenhop, 75, since 1938 president and chairman of the Commodity Exchange Rubber Clearing Association, Inc., has declined reelection to the office and has been succeeded by Frederick T. Koyle, Carl M. Loeb, Rhoades & Co., New York, N. Y. Joseph Louis, Littlejohn & Co., Inc., New York, was elected vice president of the organization.

Mr. Badenhop, board chairman of Robert Badenhop Corp., New York, helped found the Rubber Exchange in 1926 and was named one of its directors. He was also active in the formation of the Commodity Exchange, an amalgamation of four different exchanges.

Born in Hamburg, Germany, Mr. Badenhop organized his own rubber importing business in 1909, which later became Robert Badenhop Corp. He was one of the organizers of the Rubber Trade Association of New York, Inc., serving for many years on its board of directors. He was its president and chairman from 1936 to 1938.



Robert Badenhop

NSC Publishes Record of Rubber Safety Conclaves

A record of sessions held at the 1956 National Safety Congress by the Rubber Section of the National Safety Council in Chicago, Ill., October 22-26, has been published by the Council in Volume 11 of its "Current Safety Topics."

Included are reports of round-table discussions on such subjects as power tractors, fire safety in rubber plants, reclaimed-rubber plant safety, mechanical goods manufacturing safety, health hazards of new chemicals, and safety in synthetic rubber manufacturing and raw material operations.

Copies of the report are available from the National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill., at a cost depending upon the number of copies ordered.

Newly elected officers of the Council's Rubber Section, who will serve until October, 1957, are the following:

General chairman, J. L. Dean, The Firestone Tire & Rubber Co.; vice chairman in charge of program, C. E. Beck, St. Clair Rubber Co.; secretary, M. R. Batche, Firestone; Newsletter editor, W. J. Dooling, B. F. Goodrich Footwear & Flooring Co.; engineering committee chairman, D. M. Carson, United States Rubber Co.; health committee chairman, R. H. Wilson, The B. F. Goodrich Co.; membership committee chairman, C. S. Kruger, Carlisle Tire & Rubber Division of Carlisle Corp.

Also poster committee chairman, D. M. Cornell, Firestone; trade association and liaison committee chairman, A. B. Maines, Republic Rubber Division of The Lee Tire & Rubber Corp.; rules and regulations committee chairman, G. H. Burkhardt, The General Tire & Rubber Co.; publicity committee chairman, J. C. Milarch, Corduroy Rubber Co.; statistics committee chairman, Ray Hart, The Dayton Rubber Co.; mechanical goods committee chairman, C. R. Covert, The Goodyear Tire & Rubber Co.

Also, reclaim manufacturing committee chairman, R. M. Boyles, Midwest Rubber Reclaiming Co.; rubber laboratories committee chairman, K. B. Davis, B. F. Goodrich Chemical Co.; fire safety committee chairman, A. R. Pomeroy, The Ohio Rubber Co.; synthetic rubber safety association chairman, G. T. Shuster, Texas-U. S. Chemical Co.; off-the-job safety committee chairman, E. R. Gardner, Akron Chamber of Commerce, Safety Council; advisory committee chairman, H. L. Andrews, Firestone; and staff representative, John D. Gallagher, NSC.

Parker Silicone Rubber

Three new low-shrinkage silicone rubber compounds are being used by Parker Appliance Co., rubber products division, Cleveland, O., for the manufacture of O-rings and other molded parts. Designated compounds #76-128, #77-248, and #78-138, they have Shore A durometer hardness of 60, 70, 80, respectively.

Meeting specifications AMS 3303, 3304, and 3305, these compounds are said to be suitable over a temperature range of –80 to +500° F. The silicone formulations are reddish brown in color and can be handled in standard molds as used for regular synthetic rubber compounds and come out to AN size and tolerance.

Frees Isocyanate Patent

Firms licensed under E. I. du Pont de Nemours & Co.'s isocyanate patents to make urethane foams and coatings will no longer be required to pay royalties under a new policy announced by the company's elastomer chemicals department.

Affected are some 100 licensees who have been paying 1½% royalty on the selling price of urethane products manufactured under the Wilmington, Del., company's patents.

William H. Ayscue, Du Pont's isocyanate sales manager, said the new policy was designed to "further stimulate and encourage the fast-growing industry by removing the requirements of record keeping, reporting and royalty fees."

Paracril Output Up 60%

Production of Paracril, an oil-resistant synthetic rubber has been increased 60% at the Baton Rouge, La., plant of Naugatuck Chemical Division, United States Rubber Co., in a $2,000,000 expansion program just completed, according to George R. Vila, the company's vice president and general manager.

Naugatuck has also begun construction of a $7-million plant at Baton Rouge for the production of the company's Kralistic plastic materials, which will triple the firm's manufacturing capacity of the product. Completion of the project is scheduled for December.

The Paracril expansion was accomplished by adding new equipment and modifying existing units at the Baton Rouge plant.

New General Tire HQ's

The General Tire & Rubber Co., Akron, O., has opened new headquarters buildings in Charlotte, N. C.; Boston, Mass.; and Denver, Colo. Together with a recently completed addition to the company's Brittain tire warehouse in Akron, the structures provide a total of 225,000 square feet of storage, plant, and office space.

The three new headquarters will house the central offices and tire warehouses for sales divisions which tend to the tire needs of General distributors in all or portions of 15 states.

With the opening of the four structures, a major phase of its multi-million-dollar divisional construction program has been completed, the company says.

New Scrap Specifications

New "Specifications for Scrap Rubber" (revised January 29, 1957) have been issued by the Rubber Reclaimers Association, Inc., New York, N. Y. The Specifications were approved at the organization's annual meeting on January 29, and supersede those issued January 25, 1955.

The requirement that foreign scrap shipments be made c.i.f. port of entry was eliminated in the new Specifications. Other changes were: wire body tires were termed not acceptable unless specified in the purchase contract; and a 12-inch cross-section was established as the upper limit on truck tires acceptable as good delivery.

Copies of the Specifications are available from the Association's secretary, C. T. Jansen, 101 W. 31st St., New York, N. Y.

Chemical Group Elects

L. E. Johnson, International Nickel Co., has been elected president of the Commercial Chemical Development Association, New York, N. Y., and will serve the organization in that capacity until 1958. W. J. Riley, Food Machinery & Chemical Corp., was named treasurer; while G. A. Harrington, Amoco Chemicals Corp., was chosen executive secretary. W. M. Barnes, Southwest Research Institute, and W. A. Woodcock, Carbide & Carbon Chemicals Co., were elected directors. All were elected during the Association's annual meeting which was held in New York, March 28.

Cotton-Dacron Fire Hose

Goodall Rubber Co.'s new lightweight Fire-Flex cotton-and-Dacron fire hose with a reinforced rubber lining has been approved by Underwriters' Laboratories, Inc. Previous approval had been given by Factory Mutual Laboratories, the Trenton, N. J., firm says.

The hose, developed in England by George Angus Co., is being manufactured in this country under license. Claimed to be lighter in weight, more flexible, and stronger than conventional fire hose, Fire-Flex weighs less than 19 pounds per 100-foot length, compared with the 20 pounds for 50 feet of conventional hose.

News About People

Paul M. Elliott has been appointed technical coordinator of Kralistic molding compound production at the Baton Rouge, La., plant of Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. **Robert L. Knapp** succeeds him as manager of Kralistic development.

Leo L. Lewis has been appointed production manager of the titanium division of National Lead Co., New York, N. Y., succeeding **C. Y. Pfoutz,** who has retired. **Earl H. Schwartzkopf** replaces Mr. Lewis as manager of the division's Sayreville, N. J., plant.

Jerome C. Hunsaker, professor emeritus of aeronautical engineering at Massachusetts Institute of Technology and a director of The Goodyear Tire & Rubber Co. since 1946, has received the Distinguished Service Medal from the National Advisory Committee for Aeronautics for "service of fundamental significance to aeronautical science."

E. B. Newton, manager of rubber research for The B. F. Goodrich Co., Akron, O., who prepares the chapter on rubber each year for the "Encylopedia Brittanica," has prepared an article on rubber for "Brittanica Junior," encyclopedia for young people.

Roy Lippincott has been named manager of oil industry sales for Electric Hose & Rubber Co., Wilmington, Del.

E. R. Zimmerman has been promoted to supervisor, general section, The Firestone Tire & Rubber Co.'s interplant department, Akron, O. He was previously administrative assistant to the company's executive vice president, J. E. Trainer.

D. M. Nielsen has been appointed assistant district manager of the New York district sales office of Carbide & Carbon Chemicals Co., New York, N. Y. **R. H. Rehm** has been named assistant district manager of the Newark district sales office.

A CERTIFICATE OF APPRECIation on behalf of the board of directors of The Rubber Manufacturers Association, Inc, is presented to P. W. Litchfield, *right*, chairman of the board of The Goodyear Tire & Rubber Co., Akron, O., by Ross R. Ormsby, RMA president. Mr. Litchfield was cited for his contributions to the growth and the development of the rubber manufacturing industry. He served continuously on the RMA board from May, 1926, until his resignation in November, 1956.

S. M. Murray has joined the industrial products department of J. M. Huber Corp., New York, N. Y., as district representative out of the Buffalo, N. Y., office.

Robert G. Page, president of Phelps Dodge Corp., has been elected a director of New Jersey Zinc Co., New York, N. Y.

Arthur W. Sekus has been appointed assistant chief engineer at the Buenos Aires, Argentina, plant of The Firestone Tire & Rubber Co., Akron, O.

Ernest A. Swanson and **Joseph P. Flannery** have been appointed production manager and purchasing agent, respectively, for National Polychemicals, Inc., Wilmington, Mass., organic chemical manufacturer for the rubber and plastics industry.

Carroll C. Parker has been appointed grinding wheels sales manager for the mechanical goods division of United States Rubber Co., New York, N. Y.

Harry Hallworth, comptroller and former assistant treasurer of Minnesota Mining & Mfg. Co. of Canada, Ltd., London, Ont., has been elected a director and appointed treasurer of the company. At the same meeting Assistant Secretary **J. S. Little** was named secretary of the firm.

John Yacos, Jr., who recently joined The Wilson Rubber Co., Canton, O., was incorrectly described in these columns last month as the firm's new head of research and development. Mr. Yacos is actually a member of the company's technical staff.

Henry J. Edwards has been promoted to head of the San Francisco division of Dunlop Tire & Rubber Corp., Buffalo, N. Y., and is succeeded as head of the Memphis division by **Robert M. Greene,** formerly Atlanta territory salesman.

C. E. Deardorff has been appointed manager of the Tarzana, Calif., sales office of Minnesota Rubber & Gasket Co., Minneapolis, Minn.

Edward V. K. Jaycox, senior associate of the advance planning division of The Firestone Tire & Rubber Co., Akron, O., has been named administrative assistant to the company's executive vice president, **J. E. Trainer.**

W. N. Fieglein has been appointed to the southwest sales territory of Emery Industries, Inc., Cincinnati, O. He was previously a foreman in the company's production department.

George E. Hall, Jr., has been named technical advisor, pigment sales, for the Michigan Alkali Division, Wyandotte Chemicals Corp., Wyandotte, Mich. **Clyde Leaf** succeeds him as supervisor of inorganic research.

Robert W. Krebs

Robert W. Krebs has been appointed director of the chemicals research division of Esso Research & Engineering Co., New York, N. Y. **Fred W. Banes,** acting associate director of the division, has been made associate director. Dr. Krebs, formerly associate director of the Baton Rouge, La., Esso Research Laboratories, succeeds **William J. Sparks,** recently named scientific advisor to the division.

Lars Ove Oldsberg and **John J. Shay, Jr.,** have joined the research department and the sales technical service group, respectively, of the plastics division of Monsanto Chemical Co., Springfield, Mass. **Richard C. Koch** has joined the company's research and engineering division, central research department, at Dayton, O. **William R. Hayes** and **Robert A. Ginivan, Jr.,** have been named personnel managers at the St. Louis, Mo., and Everett, Mass., plants, respectively, of Monsanto's inorganic chemicals division.

Fred W. Banes

Walter G. Higgins, II

Alden H. Davis

Anthony J. Simonson

Walter G. Higgins, II, has been assigned to the New York sales staff of United Carbon Co., Inc., Charleston, W. Va.

Philip H. McLaughlin has been advanced to manager of sales administration at Stauffer Chemical Co., New York, N. Y.; while **Martin P. Kerins** has been named sales manager, industrial national accounts. Mr. McLaughlin will be in charge of product managers, sales development, and the scheduling department of the company's industrial chemical division.

Desmond M. C. Reilly has been appointed manager of technical information for the organic chemicals division of Food Machinery & Chemical Corp., New York, N. Y.

H. C. Schultze has been named a staff assistant to the directors of the development department of Carbide & Carbon Chemicals Co., New York, N. Y., at its South Charleston, W. Va., plant.

Alden H. Davis, formerly of Columbian Carbon Co., Akron, O., has been appointed resident technical service manager for Cia. Petroquimica Brasileira-Copebras, Sáo Paulo, Brazil, a joint enterprise of Columbian Carbon, Celanese Corp. of America, Traders, Inc., and Brazilian interests. Copebras, to start operations early next year, plans to manufacture carbon blacks for the rubber industry in the State of Sáo Paulo. Original planned annual capacity will be 30 million pounds of carbon black.

Samuel S. Naistat has been advanced to manager of inorganic and physical-chemical research and development for Becco Chemical Division, Food Machinery & Chemical Corp., Buffalo, N. Y. **Joseph Bomstein** has been promoted to assistant manager.

M. Peter Dreyfuss and **Jamal S. Eden** have joined the staff of The B. F. Goodrich Research Center, Brecksville, O., as technical men; while **Alan R. Siebert** has signed up as a research chemist.

Anthony J. Simonson has joined the sales staff of Thiokol Chemical Corp., Trenton, N. J., as manager of market development, in which capacity he will concentrate on market diversification.

Joseph D. Drohan has been appointed sales manager for the Eureka fire hose section of the mechanical goods division of United States Rubber Co., New York, N. Y.

William K. Taft, Jr., has rejoined B. F. Goodrich Chemical Co., Cleveland, O., following two years of military service. He has been assigned as a technical man at the company's Akron experimental station.

F. G. Stech has been promoted to group leader in charge of industrial engineering functions at the Institute, W. Va., works engineering department of Carbide & Carbon Chemicals Co., New York, N. Y. **Paul Barna** and **D. L. Cannon** have joined the technical staff of the department; while **J. F. Nelson, Jr.,** has rejoined it after a stint of army service.

4 NEW SUN RUBBER PROCESS AIDS

extend an already versatile list of products to fill all your processing requirements. Sun Oil Company's industry-leading list of high-quality products grows and grows to give you greater flexibility and economy in compounding and processing natural and synthetic rubbers.

PRODUCT	APPLICATION
CIRCOSOL 2XH. An elasticator of special hydrocarbon structures derived from petroleum.	Manufacture of oil-extended polymers. Plasticizer and softener for butadiene-styrene polymers, natural rubber, and combinations of both.
CIRCO LIGHT. A general-purpose, naphthenic type softener.	Manufacture of nonstaining reclaims and butyl inner tubes. Processing regular neoprene and natural rubber.
SUNDEX 53. A moderately aromatic product compatible with natural rubber, regular neoprene, and butadiene-styrene polymers.	Manufacture of oil-extended polymers. Processing tire tread stocks, rubber footwear, matting, toys, semihard rubbers, etc. Extending high Mooney Neoprene type WHV with a maximum loading of 50 parts per 100 parts neoprene.
SUNDEX 1585. A predominantly aromatic product compatible with natural rubber and butadiene-styrene polymers. NEW	Particularly useful in the manufacture of oil-extended polymers where easy processing and optimum aromaticity are required.
SUNDEX 85. Highly aromatic product compatible with natural rubber, butadiene-styrene polymers, neoprene (regular and WHV), and acrylonitrile polymers. NEW	Manufacture of low cost neoprene articles. Particularly useful for extending neoprene with exceptionally high loadings—75 to 100 parts Sundex-85 to 100 parts neoprene type WHV.
SUNDEX 170. A relatively aromatic product with a high molecular weight.	Manufacture of mastic floor tile, battery cases, and resinous binders.
SUNDEX 41. A complex, dark colored blend of high molecular weight petroleum fractions and a specially prepared asphaltum.	Processing natural rubber and butadiene-styrene polymers.
SUN PROCESS AID 515. A nonstaining, highly paraffinic type petroleum derivative with a low viscosity and fair processing ability.	Manufacture of butyl inner tubes. Processing natural rubber and butadiene-styrene polymers where color stability in the finished vulcanizate is important.
SUN PROCESS AID 551. A nonstaining, highly paraffinic type product with a low volatility, medium viscosity, and fair processing ability. NEW	Manufacture of oil-extended polymers where nonstaining of the finished commercial article is important.
SUN PROCESS AID 594. A medium viscosity, naphthenic type petroleum derivative with a low volatility and good processing ability. NEW	Manufacture of oil-extended polymers. Dry mixing process for natural rubber and butadiene-styrene polymers. Economical where some discoloration in the finished rubber can be tolerated.

For full information on these process aids and on Sun lubricants for rubber-process machinery, call your Sun representative or write to Dept. RW-5.

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INDUSTRIAL PRODUCTS DEPARTMENT

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Stanley L. Reid, Robert W. Vest, and **Minoru Tsutsui** have joined the central research department of Monsanto Chemical Co.'s research and engineering division at Dayton, O. **James B. Harris** is now with the company's engineering department at its Monsanto, Ill., plant; while **Donald K. Webber** has entered the technical service department of Monsanto's plastics division at Texas City, Tex. **William M. Sleichter** has joined the New York sales staff of the company's inorganic chemicals division. **Roy W. Spence** has been named special sales representative in Mississippi, Tennessee, and eastern Arkansas for Lion Oil Co. Division.

J. S. Morgan, director of utility sales for Allis-Chalmers Industries Group, Milwaukee, Wis., has been named director of domestic sales.

Henry W. DeVore has been named director of Plaskon plastics and resins sales for Barrett Division, Allied Chemical & Dye Corp., New York, N. Y., succeeding **Carleton Ellis, Jr.,** who has resigned from the company.

Henry W. DeVore

James W. Ritz

Richard W. Elder has been appointed general sales coordinator of National-Standard Co., Niles, Mich. He has been with the company since 1933.

Raymond F. Evans, chairman and chief executive officer of Diamond Alkali Co., Cleveland, O., has been elected to the board of directors of Ionics, Inc., Cambridge, Mass.

William E. Glidden, founder and former president of Glidden Coating Co., has joined the protective coatings division of Metalweld, Inc., Philadelphia, Pa.

Howard K. Norris has been appointed factory manager for the power transmission belt plant of United States Rubber Co., in Philadelphia, Pa.

Carroll Karkalits has been appointed supervisor of research for Petro-Tex Chemical Corp., Houston, Tex. Dr. Karkalits' past associations include Food Machinery & Chemical Corp. and American Cyanamid Co., where he was a group leader in the process development department.

Henri V. Krakowski and **T. M. Loring** have joined the technical staff of the Sirvene Division of Chicago Rawhide Mfg. Co., Chicago, Ill.

Joseph McGaw has joined the staff of the research and development department of Barrett Division, Allied Chemical & Dye Corp., New York, N. Y.

Mrs. Kathryn Robinson has been named commercial manager of Moda Shoe Corp., Puerto Rico, an affiliate of Wellco-Ro-Search, Waynesville, N. C.

W. R. Clarke has been advanced to operating manager to the production manager of The Firestone Tire & Rubber Co.'s Akron, O., plants. He is succeeded as Plant 2 factory manager by **C. L. Crandall. R. L. Girton** and **R. M. Jeffries** have been appointed Plant 1 division managers. Mr. Clarke succeeds **M. A. Ulman,** who is retiring.

W. John Porter, Jr., has been assigned to the New York district sales office of Baldwin-Lima-Hamilton Corp., Philadelphia, Pa., where he will direct sales of the company's Hamilton Division.

James W. Ritz has been advanced to assistant sales manager of the organic chemical sales department of Emery Industries, Inc., Cincinnati, O., succeeding **R. T. Hull,** recently named vice president and general manager of Emery Industries (Canada) Ltd.

F. Joseph Triggs, Jr., has been named to the Philadelphia office of The Goodyear Tire & Rubber Co.'s chemical division, Akron, O.

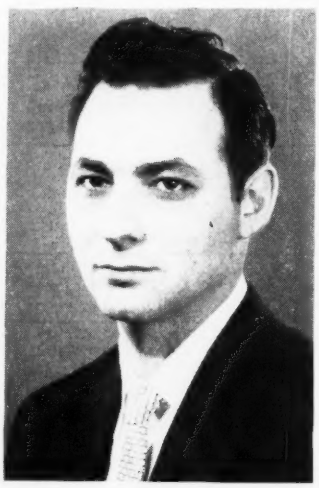
Michael Gerald O'Neil has been elected vice president and executive assistant to the president of The General Tire & Rubber Co., Akron, O. The son of General's president, William O'Neil, Michael O'Neil joined the company in 1946.

Martin Gurvitch has been appointed a chemical engineer in the research and development department, Barrett Division, Allied Chemical & Dye Corp., New York, N. Y.

Norman F. Smith, Albert Spaak and **Ruben Thevenet** have joined the Clifton, N. J., applications laboratories of the polymer chemicals division of W. R. Grace & Co.

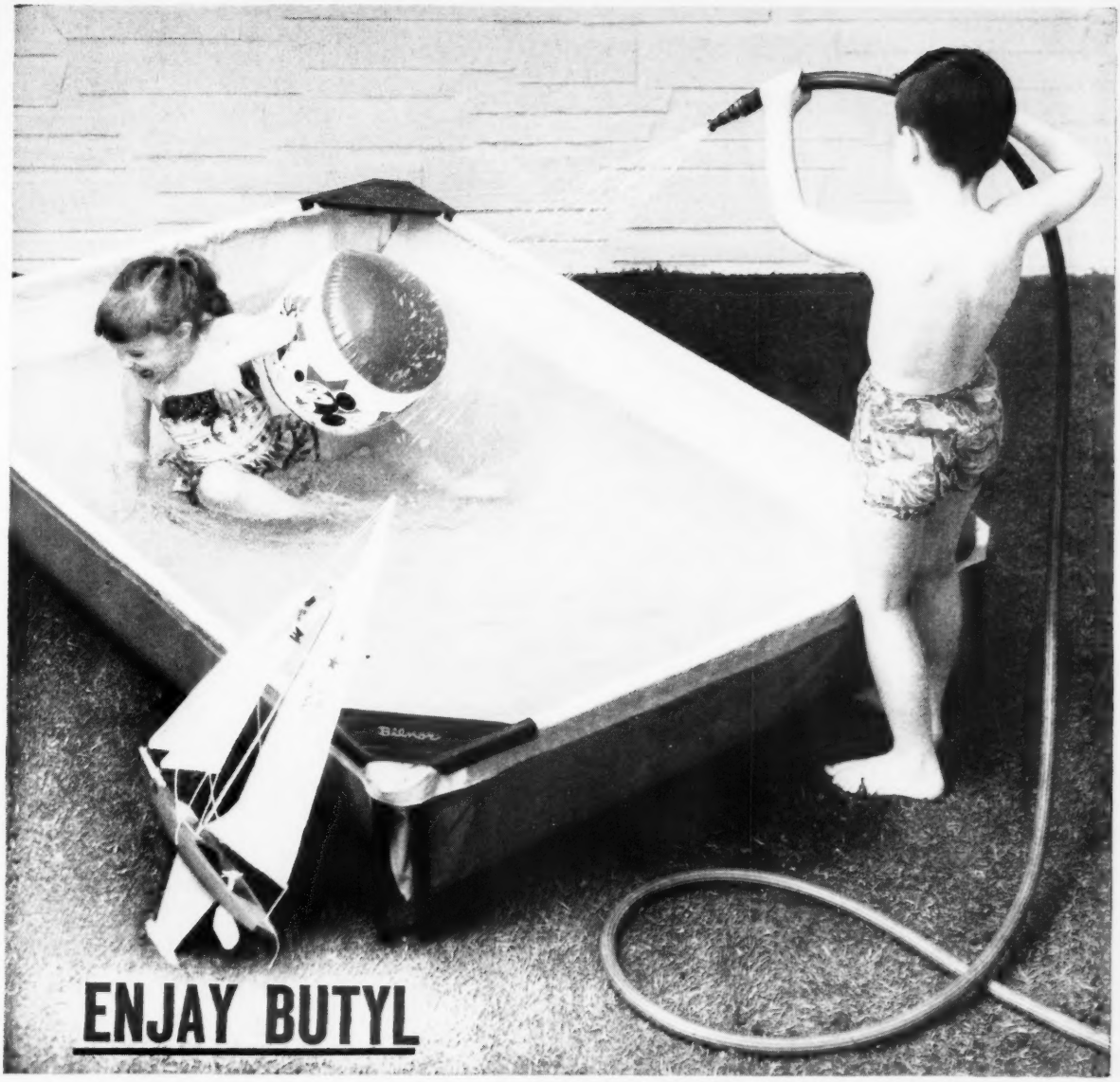
A. R. Webber has been reassigned to economic planning of production operations for B. F. Goodrich Chemical Co., Cleveland, O.

Thomas J. Zito has joined the sales staff of Thiokol Chemical Corp., Trenton, N. J., as technical sales representative.



Thomas J. Zito

F. Joseph Triggs, Jr.



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Performance! Versatility! Economy! In all three, Enjay Butyl is the world's outstanding rubber value. In laboratory tests, and in a wide variety of applications, Enjay Butyl has demonstrated its tremendous resistance to weather, sunlight, moisture, tear, impact, chipping and cracking . . . properties that set Enjay Butyl-made products apart as outstanding performers.

Children's wading pools, hot materials conveyor belts, garden hose . . . in these, and many other rubber products, Enjay Butyl out-performs and outlasts *all other* types of rubber, synthetic *or* natural. *Low-in-cost* and *immediately available* in regular and non-staining grades for white and colored applications, this truly wonder rubber may well be able to cut costs and improve performance in *your* product. For further information, and for expert technical assistance, contact the Enjay Company.

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Enjay Butyl is the greatest rubber value in the world . . . the super-durable rubber with *outstanding* resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.

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W. W. Lusk

Charles J. McCready

R. H. Steiger

W. W. Lusk has been advanced to manager of machinery sales for United Engineering & Foundry Co., Pittsburgh, Pa., which he had joined in 1936.

Joseph P. Clancy has been named eastern district sales manager of the organic chemical sales department of Emery Industries, Inc., Cincinnati, O., succeeding **J. W. Ritz,** recently appointed assistant sales manager. **Joseph E. Quinty, William C. Sowers,** and **Arthur R. McDermott** have been named representatives to the Chicago, New York, and New England areas, respectively.

James P. Barry has been named assistant sales manager, chemical sales, for Barrett Division, Allied Chemical & Dye Corp., New York, N. Y. **Henry L. Schmitt, Julian S. Pruitt,** and **Richard L. Slover** have been made chemical sales representatives to the southern New Jersey and northern Pennsylvania, Cleveland, and Detroit areas, respectively, for the Division.

John D. Barrington, president and managing director of Polymer Corp., Ltd., Sarnia, Ont., Canada, has been elected a director of McIntyre Porcupine Mines, Ltd.

A. A. Garthwaite, board chairman of Lee Rubber & Tire Corp., Conshohocken, Pa., has been reelected to his fifteenth one-year term as a board member of the National Industrial Conference Board.

A. Lyndon Foscue, Birny Mason, Jr., and **Edwin B. Suydam** have been elected vice presidents and appointed members of the appropriations committee of Union Carbide & Carbon Corp., New York, N.Y.

J. H. Pryce has been appointed general sales manager of Canada Wire & Cable Co., Ltd., Leaside, Ont. **O. W. Francoeur, W. N. Herod,** and **E. W. Johnson** have been named sales managers of the eastern, central, and western regions, respectively.

Charles J. McCready has been named general manager of The Firestone Tire & Rubber Co.'s Fall River, Mass., plant, succeeding **Frank L. Armitage,** who is retiring. McCready has been with Firestone in executive capacities since 1939.

W. Adrian King has been named general sales manager of the industrial chemicals division of Olin Mathieson Chemical Corp., Baltimore, Md.

Francis J. Boyan has been named southern sales representative at Atlanta, Ga., for The Sun Rubber Co., Barberton, O.

William J. Fritton has been appointed vice president of U. S. Rubber Reclaiming Co., Inc., Buffalo, N. Y.

R. H. Steiger has joined The C. P. Hall Co., Akron, O., as technical representative. He was formerly with The Goodyear Tire & Rubber Co.

Dennis B. Gusland has been appointed sales representative for the pigment and chemical division of Columbian Carbon (Canada), Ltd., Montreal, P.Q.

Milton L. Cameron has been named sales representative for Dominion Color Corp., Ltd., New Toronto, Ont., Canada.

James B. Bond and **John A. Peterson** have been named personnel manager and comptroller, respectively, of the new Odessa, Tex., synthetic rubber plant of the General Tire & Rubber Co., Akron, O.

News Briefs

Amoco Chemicals Corp., Chicago, Ill., is building a plant near Seymour, Ind., for the manufacture of a new, smokeless starter cartridge for jet aircraft engines. Nine separate buildings will be erected containing a total of about 22,000 square feet of floor space. The entire output of the plant, expected to be completed in early November, will be sold to the United States Air Force, which has awarded the company a contract valued at $3,412,593.

The Goodyear Tire & Rubber Co.'s Captive-Air Safety tires are being used on 1957 Studebaker-Packard station wagons, providing increased passenger space through the elimination of the spare tire.

United States Rubber Co., New York, N. Y., reports that two of its rubber-covered cellulosic fiber-and-nylon conveyor belts have carried more than six million tons of iron ore during the past five years at the Holman Cliffs Mine at Taconite, Minn. The belts are 884 and 897 feet long.

Yale Rubber Mfg. Co., Sandusky, Mich., has given 500 of its employes free anti-polio Salk vaccine shots.

E. I. du Pont de Nemours & Co., Inc., textile fibers department, has moved its rubber industry sales headquarters to the Ohio Bldg., 191 S. Main St., Akron, O.

Naugatuck NAUGAPOL

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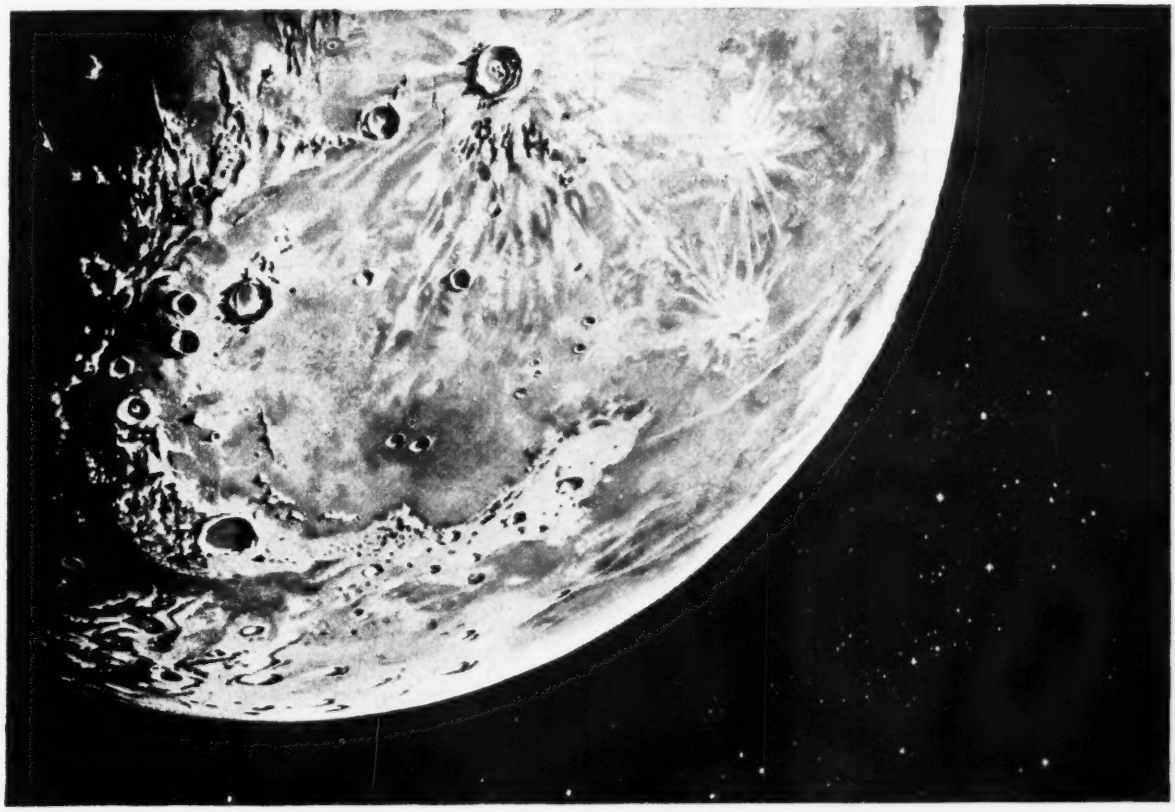

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...like the Moon

The Moon is dry because it has no atmosphere. NAUGAPOL® polymers are dry–*and stay dry*–because they are free of moisture-absorbing salts.

Special processing does it...special processing that eliminates use of salts as the coagulant. Whatever grade you require–1016, 1018*, 1019*, 1021, 1022*, 1023, 1503* or 1504*–the name NAUGAPOL is your assurance of–

- **HIGH DIELECTRIC PROPERTIES**
- **LOW MOISTURE ABSORPTION**
- **LOW ASH CONTENT**

These are the qualities that make NAUGAPOL Polymers ideal for use in electrical wire and cable insulation and in mechanical rubber products requiring good flexibility at sub-freezing temperatures. If *you* require *special properties* in synthetic rubber, come to Naugatuck!

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Division of United States Rubber Company
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US RUBBER

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Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices

Esso Standard Oil Co., New York, N. Y., has formed a highway traffic department to conduct long-range studies and programs in the fields of traffic safety and highway development. John J. Hall and Harry J. Green have been named manager and assistant manager, respectively, of the new department.

The Goodyear Tire & Rubber Co., Akron, O., has cut by 5½% the price of its Vitafilm heavy-duty packaging material, a product of its films and flooring division. The company, by expanding Vitafilm production facilities, will soon increase output of this material by almost 150%.

Minnesota Rubber & Gasket Co., Minneapolis, Minn., has acquired the assets of General Industrial Products Co., Inc., Minneapolis, producer of sprayed, dipped, and formed rubber parts, which will be operated as a division of Minnesota Rubber to be known as Minnesota Latex Rubber Co.

Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn., has dropped its use of colored end tapes and stripes as an identifying system for its shipped bags of Paracril synthetic rubbers in favor of stenciled grade designations each side of the bags as well as the face.

Borden Co., New York, N. Y., has begun operations at its second southern formaldehyde and resins plant at Fayetteville, N. C. The new facility will also serve as a warehouse for polyvinyl acetate and polyvinyl alcohol, serving the textile, paint, and adhesives industry.

Rubber Products, Inc., Gardena, Calif., has absorbed Excel Rubber Co., Los Angeles, Calif., which will work on missile applications as a wholly owned subsidiary. Bert Reynolds, formerly head of Excel, has been named vice president and chief chemist for both organizations.

United States Rubber Co., New York, N. Y., will spend $1-million to expand production facilities for nylon tire fabric at its Scottsville, Va., plant, operated by the company's textile division.

Emulsol Chemical Division, Witco Chemical Co., has moved its sales department to the Lincoln Tower Bldg., 75 E. Wacker Dr., Chicago, Ill., where the parent company's Midwest regional sales headquarters are located.

Columbian Carbon (Canada), Ltd., Montreal, P.Q., has been appointed sales agent for reclaimed rubber produced by the industrial products division of B. F. Goodrich Co., Akron, O. The appointment covers the Canadian rubber industry.

Pennsylvania Industrial Chemical Corp., Clairton, Pa., has established a district office at 2640 Canal St., New Orleans, La., with Bernard J. Davis as district manager.

R. T. Vanderbilt Co., New York, N. Y., has added to its line of rubber chemicals Thiate A, an accelerator of G and W types of neoprene said to provide good processing safety and fast curing rates. Samples and technical information are available on request from the supplier.

United States Rubber Co.'s rubber mats have replaced the traditional flooring of sawdust in Ringling Bros. & Barnum & Bailey's circus. One-hundred-twenty-eight yellow mats totaling 16,000 square feet were used when the circus opened in New York's Madison Square Garden on April 4. These mats are ¼-inch thick, have a bright yellow surface with a non-slip pyramid design, and were developed and produced just for the circus by U. S. Rubber.

Wyandotte Chemicals Corp., Wyandotte, Mich., is building a "large capacity" plant for additional output of its Pluronic and Tetronic polyols, as well as production of other chemicals now in development. The plant will be known as the oxide products plant. Completion is scheduled for late this year.

B. F. Goodrich Co., Akron, O., has developed special high-speed tires to be used on the main landing gear of North American Aviation's X-10 test vehicle for the SM-64 Navaho intercontinental guided missile. The tires, 32 x 8.8 with 14-ply rating, are inflated to 250 psi.

J. C. Clinefelter Co., Akron, O., has been formed by James W. and Robert C. Clinefelter, who were associated with their father, the late James C. Clinefelter, in recent years. They will continue to represent John Royle & Sons, Paterson, N. J., in the Midwest.

B. F. Goodrich Chemical Co.'s synthesis of vinylidene dinitrile in 1947 was responsible for the development of Darlan and its introduction last year, the company says. The new synthetic fiber is produced by the reaction of vinylidene dinitrile with vinyl acetate.

The Dayton Rubber Co., Dayton, O., has made its automotive wholesalers division, sales representative through automotive parts distributors and jobbers of the automotive tape line of its Holfast division, Atlanta, Ga.

The Goodyear Tire & Rubber Co., Akron, O., has opened its new $750,000 Dallas, Tex., district offices and warehouse building.

Monsanto Chemical Co., St. Louis, Mo., is expanding the capacity of its Texas City, Tex., acrylonitrile plant to more than 100 million pounds a year.

Arrowhead Rubber Co., Long Beach, Calif., has been merged into Federal-Mogul-Bower Bearings, Inc., and will be known as its National Seal Division.

The Timken Roller Bearing Co., Canton, O., has moved its Buffalo, N. Y., industrial and steel sales office to 2960 Main St.

J. M. Huber Corp., New York, N. Y., has opened a new sales office at 48 Neumann Parkway, Buffalo, N. Y., and is also extending the area covered by its Chicago office to include western Michigan, Indiana, Illinois, and west and south to Texas.

National-Standard Co., manufacturer of tire bead wire, wire cloth, special machinery, etc., is increasing its manufacturing space at Niles, Mich., to more than 400,000 square feet by erection of a new 16,000-square foot one-story addition.

Diamond Alkali Co., Cleveland, O., has substituted a "chemical diamond" for its old horizontal green diamond trade mark. The new design is a vertical red diamond within a black retort-like symbol.

United States Rubber Co., New York, N. Y., has completed the transfer of all personnel and equipment from its old central laboratories at Passaic, to the new research center at Wayne, N. J.

Chase Chemical Corp., Pittsburgh, Pa., has named Innis, Speiden & Co., Chicago, Ill., exclusive selling agent in Wisconsin, Illinois, Indiana, and western Michigan for its polyisocyanate resins.

Dunlop Tire & Rubber Corp., Buffalo, N. Y., has recorded radio commercials stressing its use of atomic energy for tire development and is making these recordings available to its dealers for use on local radio stations.

Baker Castor Oil Co., New York, N. Y., subsidiary of National Lead Co., has become a member of The Hundred Year Association of New York, Inc. The firm was established in Jersey City in 1857.

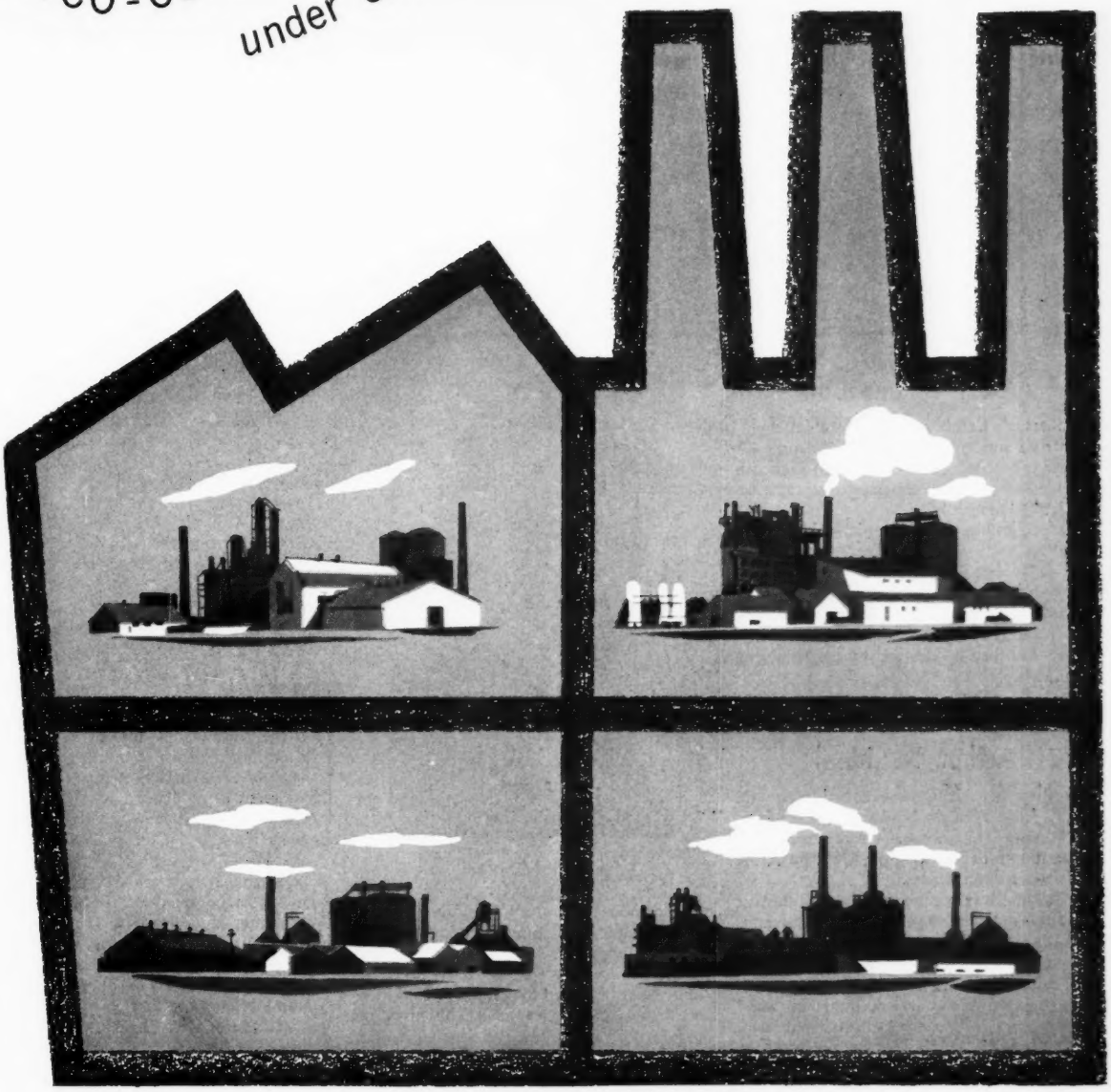
Diamond Alkali Co., Cleveland, O., has launched a training program designed to broaden the advancement opportunities of newly employed chemical engineering graduates. R. L. Annis has been named program supervisor.

Pennsylvania Salt Mfg. Co., Philadelphia, Pa., has changed its name to Pennsalt Chemicals Corp. as being more descriptive of the company's activities.

United States Rubber Co., New York, N. Y., has opened its new Dedham, Mass., branch office which will serve as the company's New England outlet.

Goodrich-Gulf Chemicals, Inc., Cleveland, O., is making available in a crumb form all hot types of its Ameripol synthetic rubber. The crumb form eliminates the necessity of milling or chopping bales.

WITCO-CONTINENTAL carbon black plants... under one quality roof!



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Separate locations—yes...but the same high quality comes from all Witco-Continental plants. Produced under strict laboratory control, these rubber blacks are designed to meet all customer specifications.

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37 Years of Growth

The Firestone Tire & Rubber Co., Akron, O., is conducting a farm-tire loaner program in which company technicians remove worn tires from tractor wheels and replace them with new tires on a free-loaner basis while the old tires are in the process of being repaired or retreaded.

Chicago Rawhide Mfg. Co., Chicago, Ill., has begun operations at its new 12,500-foot addition to its Sirvene Division's plant, Elgin, Ill., which will serve as a special polymer section for the manfacture of custom molded synthetic rubber parts from silicones, Kel-F Elastomers, fluoro rubbers, and Teflon.

Obituaries

Albert F. Larabee

Albert F. Larabee, formerly chief engineer of Pennsylvania Rubber Co. and of the Pennsylvania Division of The General Tire & Rubber Co., serving from 1929 to 1953, died April 1.

Before joining Pennsylvania Rubber, Mr. Larabee was chief engineer for Mason Tire & Rubber Co., with which he became associated in 1925.

Funeral services were held April 4 in Greensburg, Pa.

Mr. Larabee is survived by his wife and two sons.

Arthur M. Neal

Arthur M. Neal, assistant director of the E. I. du Pont de Nemours & Co., Inc., Elastomers Department Laboratory, died at his home in Wilmington, Del., on April 18, after a long illness.

Dr. Neal was recognized as an authority on rubber technology generally and specifically on organic antioxidants, antiozonants, peptizers, and accelerators for natural and synthetic rubber. He wrote 15 articles for technical journals on elastomers and related chemicals and was the author of the chapter on neoprene in the recent monograph on "Synthetic Rubber," edited by G. S. Whitby and published under the auspices of the Division of Rubber Chemistry of the American Chemical Society. The deceased also held 37 patents on rubber chemicals and isocyanates.

Art Neal, as he was known by his many friends, was secretary of the Rubber Division, ACS, and councillor representing the Division on the governing board of the parent Society. He was a member and secretary of the standing committee of ACS on national meetings and divisional activities.

He was born in West Boylston, Mass., July 11, 1902. He received his B.A. and M.A. from Clark University in 1923 and 1924, respectively, and his Ph.D. in chemistry from Brown University in 1927.

After a short period of employment with Grasselli Chemical Co., he joined Du Pont as a research chemist in 1929. In 1938 he was named acting division

Arthur M. Neal

head of the Laboratory, and in 1942 he was appointed assistant director of the rubber laboratory, now the Elastomers Laboratory.

Dr. Neal belonged to Lambda Chi Alpha and Sigma Xi. He was also a member of the board of trustees of the Second Baptist Church of Wilmington when he died.

He is survived by his wife and one son.

Funeral services were conducted in Wilmington on April 22.

Clarence S. Pope

Clarence Sherwood Pope, general sales manager of Gutta Percha & Rubber, Ltd., Toronto, Ont., Canada, died at his home in Toronto in early April.

Mr. Pope joined Gutta Percha in 1919 in its export department, and later became manager of the department. In 1950 he was appointed assistant general sales manager, advancing to general sales manager five years later. In that capacity he traveled widely throughout the world.

He was born and educated in Wiarton, Ont. He also saw service in World War I.

The deceased is survived by his wife, a son, a brother, and a sister.

J. Fred Schott

J. Fred Schott, development manager of the footwear and general products division, United States Rubber Co., New York, N. Y., died suddenly of a heart attack at his home in Mishawaka, Ind., April 4, while on a leave of absence from the company (since March 1) because of ill health.

The deceased was born in Pine Meadows, Conn., June 17, 1896. He attended Nazareth Hall Military School before entering Lebanon Valley State College, Lebanon, Pa. He continued his education at Pierce Business College.

Mr. Schott joined U. S. Rubber in January, 1917, and was assigned to development work at the company's Mishawaka plant. Successive promotions over the years brought him to the post of director of the footwear and general products division's development laboratories in 1939. He was named development manager of the division in 1954. Mr. Schott was very active in the development of Koylon foam, automats, Royalite, and many other products for U. S. Rubber.

Funeral services were held at St. Paul's Episcopal Church, Mishawaka, April 6. Burial took place the same day.

Surviving are Mr. Schott's wife and four children.

John W. McConnell

John W. McConnell, a director and secretary of The Polson Rubber Co., Garrettsville, O., died April 1 while hospitalized for surgery. He had been associated with the company for 30 years.

Mr. McConnell was a newspaperman in New York and Chicago before joining Polson in 1927 as a salesman. He advanced to sales manager in 1932, assistant secretary of the company in 1944, a director a year later, and secretary in 1946.

The deceased was born in Norwich, Conn., in 1883.

Funeral services were held at Tinker Funeral Home, Kent, O., April 3. Burial was in Memorial Cemetery, Lima, O., the following day.

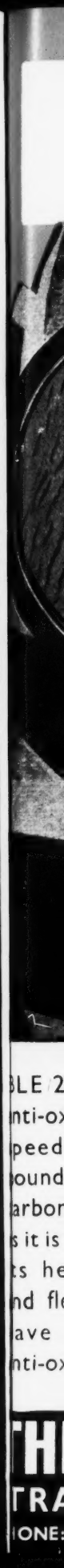
Surviving are Mr. McConnell's wife, a son, a daughter, two brothers, a sister, and five grandchildren.

Charles H. Brook

Charles H. Brook, 74, comptroller of The Goodyear Tire & Rubber Co., Akron, O., from 1921 until 1952, died of a heart attack on April 11 near Savannah, Ga., while on an automobile trip. He had resigned his post with Goodyear in 1952 because of ill health.

Born in London, England, he was educated in English schools, passed the examinations of the Institute of Chartered Accountants with honors, and became a chartered accountant.

He came to the United States in 1912 and became associated with Price, Waterhouse & Co. as a chartered accountant. He joined Goodyear in 1921.



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Financial

Allis-Chalmers Mfg. Co., Milwaukee, Wis. Initial quarter, 1957: net earnings, $5,100,158, equal to 61¢ a share, against $5,768,599, or 71¢ a share, in the 1956 quarter.

American Cyanamid Co., New York, N. Y., and subsidiaries. First quarter, 1957: net income, $13,000,000, equal to $1.23 a common share, against $12,302,000, or $1.16 a share, in the 1956 period; sales, $132,125,000, against $127,793,000.

Anaconda Co., New York, N. Y. For 1956: net income, $111,502,358, equal to $12.85 a share, compared with $65,256,306, or $7.52 a share, a year earlier.

Anaconda Wire & Cable Co., New York, N. Y. For 1956: net income, $9,624,274, equal to $11.40 a capital share, compared with $7,015,496 or $8.31 a share, in 1955; net sales, $159,352,097, against $145,217,992; federal income taxes, $9,850,000, against $7,450,000.

Armstrong Cork Co., Lancaster, Pa. Three months ended March 31, 1957: net profit, $2,865,000, equal to 55¢ a share, against $3,698,000, or 72¢ a share, in the 1956 quarter; net sales, $60,923,000, against $61,520,000.

Borg Warner Corp., Chicago, Ill., and subsidiaries. Quarter ended March 31, 1957: net profit, $8,928,356, equal to $1.00 a common share, against $9,691,005, or $1.08 a share, a year earlier; net sales, $164,543,222, against $162,561,136.

Canada Wire & Cable Co., Ltd., Leaside, Ont. For 1956: net earnings, $1,955,489, compared with $2,037,019 in 1955.

Carborundum Co., Niagara Falls, N. Y. Initial quarter, 1957: net earnings, $1,468,614, equal to 85¢ a share, against $1,611,685, or 94¢ a share, in the 1956 period.

Columbian Carbon Co., New York, N. Y. For 1956: net earnings, $4,834,356, equal to $3.00 a share, against $6,305,977, or $3.01 a share in 1955; net sales, $65,529,600, against $62,781,200; income taxes, $3,210,000, against $3,500,000.

Diamond Alkali Co., Cleveland, O. First quarter, 1957: net income, $2,225,048, equal to 84¢ a common share, against $2,740,575, or $1.02 a share, a year earlier; sales, $30,932,903, against $30,638,686.

Crown Cork & Seal Co., Inc., Baltimore, Md. For 1956: net income, $380,982, equal to $1.38 each on 275,000 preferred shares, contrasted with $1,824,038, or $1.05 each on 1,207,790 common shares, the year before; sales, $115,098,613, against $112,953,722.

First quarter, 1957: net loss, $445,470, contrasted with net profit of $54,431, or 20¢ a preferred share, in the corresponding months of 1956; net sales, $27,856,672, against $27,367,616.

Detroit Gasket & Mfg. Co., Detroit, Mich. For 1956: net income $279,615, equal to 36¢ a share, contrasted with $2,062,940, or $2.65 a share, in 1955.

DeVilbiss Co., Toledo, O. For 1956: net income, $1,790,625, equal to $4.98 a share, against $1,482,616, or $4.01 a share, in 1955.

Dow Chemical Co., Midland, Mich., and subsidiaries. Nine months ended February 28, 1957: net earnings, $38,005,232, equal to $1.54 a share, compared with $42,622,456, or $1.82 a share, in the 1956 period; net sales, $462,257,333, against $410,891,687.

Du Pont of Canada (1956), Ltd., Montreal, P.Q., Canada. For 1956: net income, $4,969,135, equal to 67¢ a share, against $6,493,976, or 88¢ a share, in 1955.

General Cable Corp., New York, N. Y. January 1-March 31, 1957: net earnings, $3,013,047, equal to $1.06 a share, against $2,188,621, or 91¢ a share, in the 1956 period.

General Electric Co., Schenectady, N. Y. Initial quarter, 1957: consolidated net earnings, $64,006,000, equal to 73¢ a capital share, compared with $54,962,000, or 63¢ a share, in the like period last year.

General Tire & Rubber Co., Akron, O., and subsidiaries. Quarter ended February 28, 1957: net profit, $3,250,400, equal to $1.95 a share, against $2,273,240, or $1.40 a share, a year earlier; net sales, $95,497,316, against $83,523,606.

Mansfield Tire & Rubber Co., Mansfield, O., and subsidiaries. Year to December 31, 1956: net income, $1,376,683, equal to $2.23 each on 552,504 common shares, compared with $1,768,203, or $3.00 a share, in the preceding year; net sales, $61,557,595, against $74,555,659; federal income taxes, $1,321,794, against $1,688,250.

B. F. Goodrich Co., Akron, O. March quarter, 1957: net profit, $10,160,824, equal to $1.14 a common share, against $10,082,972, or $1.14 a share, a year earlier; net sales, $183,684,493, against $180,295,218.

Hercules Powder Co., Wilmington, Del. First three months, 1957: net profit, $4,087,904, equal to 48¢ a common share, against $4,544,522, or 55¢ a share, in the 1956 quarter; sales, $60,867,639, against $57,362,562.

Hewitt-Robins, Inc., Stamford, Conn., and domestic subsidiaries. Year ended December 31, 1956: net profit, $1,362,175, equal to $3.35 each on 383,436 common shares, compared with $1,282,927, or $3.31 each on 301,431 shares, the year before; net sales, $55,454,245, against $47,132,792; federal income taxes, $1,289,523, against $1,282,927; current assets, $23,633,066, current liabilities, $8,179,489, against $18,105,715 and $7,433,496, respectively, on December 31, 1955.

First quarter, 1957: net earnings, $330,574, equal to 81¢ a share, against $291,659, or 71¢ a share, in last year's period; net sales, $15,318,340, against $12,330,697.

Hooker Electrochemical Co., Niagara Falls, N. Y. Three months ended February 28, 1957: net income, $2,192,100, equal to 33¢ a common share, compared with $2,768,100, or 46¢ a share, a year earlier; net sales, $25,864,800, against $26,092,500.

Johns-Manville Corp., New York, N. Y., and subsidiaries. Quarter ended March 31, 1957: net profit, $2,953,554, equal to 41¢ a share, compared with $4,110,948, or 64¢ a share, a year earlier; sales $65,654,473, against $64,674,506.

I. B. Kleinert Rubber Co., New York, N. Y. For 1956: net earnings, $533,291, equal to $1.74 a share, against $533,067, or $1.76 a share, in 1955.

Lee Rubber & Tire Corp., Conshohocken, Pa., and domestic subsidiary. Quarter ended January 31, 1957: net income, $336,417, equal to 40¢ a common share, against $312,795, or 37¢ a share, a year earlier; net sales, $10,612,968, against $10,845,626.

McNeil Machine & Engineering Co., Akron, O. For 1956: net earnings, $3,073,733, (a new high), equal to $5.07 a common share, compared with $2,435,353, or $4.22 a share, in 1955; sales, $36,410,268, (another record), against $23,748,979.

Merck & Co., Rahway, N. J. Twelve months ended March 31, 1957: net earnings, $20,300,000, equal to $1.93 a share, against $18,500,000, or $1.71 a share, in the preceding months.

National Automotive Fibres, Inc., Trenton, N. J. For 1956: net loss, $1,821,001, contrasted with net profit of $2,164,062 a year earlier.

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The Mohawk Rubber Co., Akron, O. For 1956: net profit, $370,525; net sales, $15,126,701; federal income taxes, $401,526; current assets, $6,489,312, current liabilities, $2,848,884.

Monsanto Chemical Co., St. Louis, Mo., and domestic and Canadian subsidiaries. First quarter, 1957: net profit, $11,534,000, equal to 54¢ a common share, against $11,255,291, or 53¢ a share, in the 1956 quarter; net sales, $151,285,000, against $140,611,232.

National Lead Co., New York, N. Y. For 1956: net earnings, $63,152,087, equal to $5.34 a share, compared with $47,889,941, or $4.02 a share, the year before; net sales, $576,292,383, against $533,728,730.

Initial quarter, 1957: net earnings, $14,772,818, equal to $1.22 a share, against $13,715,511, or $1.13 a share, in the corresponding period of 1956.

National Rubber Machinery Co., Akron, O. For 1956: net income, $691,111, equal to $3.53 a share, against $516,249, or $2.64 a share, the year before; net sales, $16,154,858, against $11,553,876; federal income taxes, $705,341, against $642,348.

The New Jersey Zinc Co., New York, N. Y., and subsidiaries. Year ended December 31, 1956: net profit $2,570,650, equal to $1.31 a share, compared with $4,826,284, or $2.46 a share, in 1955; net sales, $20,033,380, against $20,408,344; federal income taxes, $1,345,089, against $3,675,000.

Okonite Co., Passaic, N. J. For 1956: net earnings, $1,675,125, equal to $8.21 a share, against $1,559,497, or $8.18 a share, in 1955.

Quarter ended March 31, 1957: net profit, $139,589, equal to 68¢ a share, compared with $462,234, or $2.41 a share, in the like period last year.

The Pantasote Co., Passaic, N. J. For 1956: net profit $104,767, contrasted with $2,270 in 1955; sales $4,533,373, against $4,418,284.

Parke, Davis & Co., Detroit, Mich. For 1956: net income, $17,645,728, equal to $3.59 a share, against $14,322,015, or $2.92 a share, the year before.

Quarter ended March 31, 1957: net income, $5,598,589, equal to $1.14 a share, against $4,196,864, or 86¢ a share, in the corresponding months of 1956; net sales, $37,785,630, against $32,549,037.

Polymer Corp., Ltd., Sarnia, Ont., Canada. Year ended December 31, 1956: net income, $9,450,380, compared with $7,531,200 in the previous year; net sales, $71,175,758, against $61,590,151; income tax, $8,395,000, against $6,639,000; current assets, $27,865,452, current liabilities, $8,603,418, against $25,562,474 and $7,745,346, respectively, on December 31, 1955.

Parker Appliance Co., Cleveland, O. Nine months to March 31, 1957: net income, $1,225,103, equal to $2.41 a share, contrasted with $108,496, or 23¢ a share, a year earlier.

Pennsalt Chemicals Corp., Philadelphia, Pa. First quarter, 1957: net profit, $1,035,500, equal to 81¢ a share, compared with $895,200, or 72¢ a share, in the 1956 quarter; sales, $19,111,000, against $17,256,000.

Phelps Dodge Corp., New York, N. Y. For 1956: net earnings, $86,975,682, equal to $8.58 a share, against $72,319,224, or $7.13 a share, in 1955.

March quarter, 1957: net profit, $15,200,000, equal to $1.50 a share, contrasted with $25,800,000, or $2.55 a share, in the 1956 quarter.

H. K. Porter Co., Pittsburgh, Pa. March quarter, 1957: net income, $1,661,756, equal to $1.54 a share, compared with $2,059,251, or $1.92 a share, a year earlier.

Raybestos-Manhattan, Inc., Passaic, N. J., and domestic subsidiaries. Year ended December 31, 1956: net profit, $4,108,235, equal to $6.54 each on 628,100 capital shares, compared with $3,738,496, or $5.95 a share, in 1955; net sales, $84,630,819, against $82,905,705; income taxes, $4,420,000, against $3,683,000, current assets, $33,685,764, current liabilities, $7,665,723, against $31,946,380 and $8,642,088, respectively, on December 31, 1955.

Seiberling Rubber Co., Akron, O., and subsidiaries. First quarter, 1957: net earnings, $182,542, equal to 31¢ a share, against $176,168, or 29¢ a share, in the previous year's quarter; net sales, $10,501,219, against $10,716,356.

Sheller Mfg. Corp., Portland, Ind., and subsidiaries. For 1956: net profit, $1,271,606, equal to $1.33 a capital share, contrasted with $3,754,515, or $3.94 a share, the year before; net sales, $41,071,196, against $55,593,663; income taxes, $1,425,000, against $3,750,000.

Sun Oil Co., Philadelphia, Pa., and subsidiaries. For 1956: net income, $56,160,053, equal to $5.22 a common share, against $48,307,360, or $4.72 a share, in 1955; federal income taxes, $20,000,000, against $14,700,000.

Taylor Instrument Cos., Rochester, N. Y. Six months to January 31, 1957: net earnings, $815,953, equal to $4.32 a share, contrasted with $184,909, or 98¢ a share, a year earlier.

Thiokol Chemical Corp., Trenton, N. J. For 1956: net earnings, $952,335, equal to $2.00 a share, compared with $536,727, or $1.40 a share, in 1955; net sales, $21,013,527, against $13,530,160.

Thermoid Co., Trenton, N. J., and subsidiaries. For 1956: net earnings, $1,871,632, equal to $2.13 a common share, against $1,614,343, or $1.88 a share in 1955; gross sales, $41,806,585, against $40,607,549.

U.S. Rubber Reclaiming Co., Inc., Buffalo, N. Y. For 1956: net loss, $291,188, contrasted with net profit of $479,153 the year before.

Union Asbestos & Rubber Co., Chicago, Ill. For 1956: net profit, $14,668, contrasted with net loss of $270,813 in 1955.

First quarter, 1957: net profit, $150,000, equal to 32¢ a share, contrasted with net loss of $85,665 in the 1956 months.

Union Carbide & Carbon Corp., New York, N. Y., and subsidiaries. First quarter, 1957: net income, $35,454,638, equal to $1.18 a share, against $37,673,547, or $1.25 a share, in the corresponding period last year; net sales, $351,320,030, against $320,493,019.

United Carbon Co., Charleston, W. Va., and subsidiaries. Twelve months ended December 31, 1956: net earnings, $6,013,326, equal to $5.04 a common share, compared with $5,560,210, or $4.66 a share, in the preceding 12 months; net sales, $59,721,769, against $50,087,818; income taxes, $4,585,000, against $4,055,000.

United Elastic Corp., Easthampton, Mass. For 1956: net income, $3,742,755, equal to $4.47 a share, compared with $3,362,184, or $3.42 a share, in 1955.

United Engineering & Foundry Co., Pittsburgh, Pa., and subsidiaries. Year to December 31, 1956: net earnings, $3,219,712, equal to $1.28 a common share, compared with $2,192,608, or 87¢ a share in 1955; net sales, $62,696,397, against $47,723,198; income taxes, $3,531,000, against $2,406,000.

West Virginia Pulp & Paper Co., Charleston A, S. C., and subsidiaries. Quarter ended January 31, 1957: net profit, $2,920,000, equal to 56¢ a common share, compared with $4,446,000, or 87¢ a share, in the 1956 period; sales, $46,806,000, against $46,723,000.

Westinghouse Electric Corp., Pittsburgh, Pa., and subsidiaries. For 1956: net profit, $3,492,061, equal to 10¢ a common share, contrasted with $42,802,747, or $2.46 a share, in 1955; sales, $1,525,375,771, against $1,440,976,985; federal income taxes, $1,800,000, against $41,300,000.

S. S. White Dental Mfg. Co., Philadelphia, Pa., and domestic and Canadian subsidiaries. For 1956: net profit, $942,461, equal to $2.56 a capital share, against $934,154, or $2.54 a share, in 1955; net sales, $22,709,060, against $21,924,036; income taxes, $835,000, against $897,000.

(Continued on page 312)

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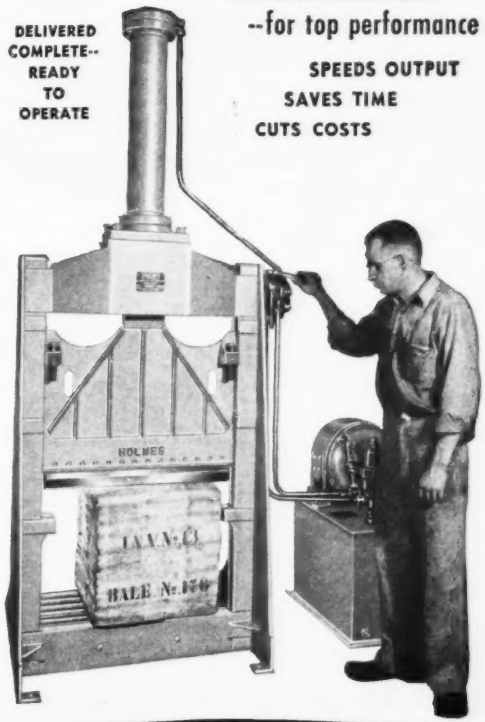

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News from Abroad

Malaya

Rubber Production, Exports Down Slightly in 1956

Rubber production for all Malaya was off 1.8% in 1956 as compared with 1955 output. The decline from 639,128 tons to 627,388 tons was entirely due to a 4% drop in output from smallholdings, which in turn was the direct result of lower rubber prices during 1956. In that year, estates accounted for 353,007 tons, against 352,916 tons—an increase of 91 tons, which might have been greater but for the "go-slow" action of tappers in May, 1956. The share of smallholders was 274,381 tons in 1956, as compared with 286,212 tons the year before. The output of special rubbers last year came to 8,581 tons, of which 361 tons were softened rubber (including rubber containing peptizers) and 37 tons chemically modified rubber (cyclized rubber and rubber powder); the remainder consisted of various unspecified, specially treated rubbers.

Revised figures for latex production put the total at 88,047 tons for 1956, of which 72,507 tons were centrifuged concentrate, 7,444 tons cream concentrate, and 8,096, other types, including Revertex and electro-creamed latex.

Malayan latex exports declined sharply last year, reflecting cutbacks in automobile production in the United States and consequent reduced demand for foam latex car upholstery, and also—though to a smaller degree—the tightening of regulations on installment buying in the United Kingdom, which hit the demand for foam rubber for furniture. The latex shipments in 1956, at 92,182 tons, were the lowest since 1953, and represented a decrease of 14.5% from the 1955 figure. The United States took 27,605 tons, 38.9% less than the year before, and the United Kingdom, 26,282 tons, or 15.6% less. On the other hand increased amounts went to Germany (9,320 tons, 31.2% more) France (6,027 tons, 21.4% more) and Japan (5,428 tons, 68% more).

It is thought that the relatively poor demand for latex from the United States might have caused some estates, notably in Johore, to switch from latex to sheet production. In any case, exports of ribbed smoked sheets in 1956 came to 627,222 tons, against 621,955 tons in 1955.

Rubber imports totaled 365,824 tons in 1956, not quite 1% above the 1955 amount and the highest since 1951. It is noted, however, that lower grades accounted for only 14% of the imports last year, against 15% in 1955 and 33.6% in 1954. Malayan exports of rubber in 1956 totaled 983,282 tons, against 994,179 tons in 1955. The United Kingdom was again Malaya's best customer, taking 232,407 tons; next came the United States with 155,228 tons; Western Germany with 81,735 tons; Japan, 74,529 tons; France, 72,178 tons; Italy, 56,098 tons; Canada, 34,623 tons; Australia, 30,478 tons. Of the South American countries, Argentina ranked first, with 20,224 tons. The direct purchases by Iron Curtain countries totaled 43,823 tons (Poland, 17,417 tons; Czechoslovakia, 13,200 tons; U.S.S.R. 12,791 tons; and Hungary 415 tons). Communist China's direct purchases from Malaya since the lifting of destinational control came to 8,707 tons.

According to figures published for 1957 so far, Malayan rubber exports amounted to 240,844 tons the first quarter of 1957. During this period, it may be added, there were repeated rumors that China was interested in buying considerable amounts of rubber (130,000 tons were mentioned earlier in the year, but the latest figure seems to be 100,000 tons) from southeast Asian countries. It appears that she did indeed contract for the purchase of 5,000 tons of rubber from Indonesia last March so that some Singapore rubber men figured that Malaya might be asked to supply up to half the total contemplated purchases, which led to brief flutters on the Singapore market. To early April, however, no orders from Red China had been received in Malaya.

New Planting Scheme

The Rubber Industry Replanting Board is considering a new plan to overcome the understandable reluctance of many smallholders to replant. This is a block planting scheme involving the opening up of new land on a cooperative estate basis, with maximum estate area of 250 acres. Participants will not have to cut down their existing holdings and replant until after their block planting areas have reached the tapping stage—normally in seven years. Up to eight acres of new land will be allotted, it is understood, and at least six acres of this must be planted with rubber; the remaining two acres may be planted with approved crops.

So far the replanting scheme for smallholders has been only moderately successful; of the 220,300 acres they were supposed to have replanted during 1953-1956, only about 58% has been replanted under the scheme and required the payment by government of $36,833,187 (Straits currency) in replanting grants.

The new plan, if properly backed and carried out may, incidentally, help curb a trend disturbing many who have the welfare of the country and the industry at heart; this is, the growing fragmentation of rubber estates.

Fragmentation of Estates

This development seems a recent one made possible by the anxiety of many estate owners to dispose of their land while they are able to do so at a profit. Speculators buy up these estates, generally moderate and smaller sized properties, then split them up into plots from three to ten or at most 15 acres, which they sell on mortgage at a high price. As the *Straits Times* recalls in a recent editorial on the subject, the International Bank Mission strongly warned against fragmentation, in its report on the economic development of Malaya, stating:

"Fragmentation leads to uneconomic holdings, concealed unemployment, increased indebtedness, reduced productivity . . . and in general has a demoralizing effect on a rural community."

The matter of fragmentation was brought to public notice when an estate of 1,389 acres in Pahang was recently broken up into lots of three to 15 acres and sold to 191 persons; the former workers were deprived of their jobs and had to seek work elsewhere. A report by the Labor Department reveals that probably at least a dozen other estates, ranging in size from 70 to 600 acres, situated in various parts of Malaya, have been bought up and similarly split.

Natural vs. Synthetic Rubber

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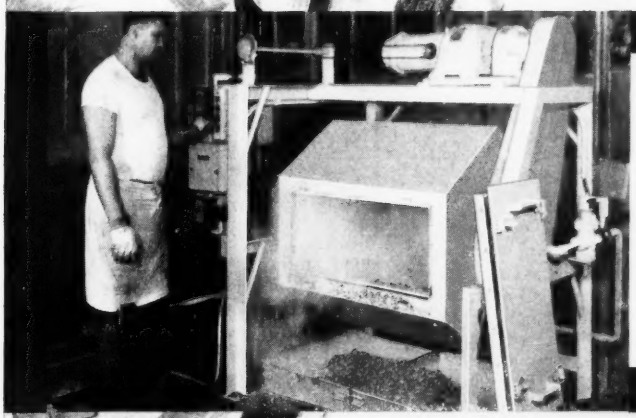

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News from Abroad

Malaya

Rubber Production, Exports Down Slightly in 1956

Rubber production for all Malaya was off 1.8% in 1956 as compared with 1955 output. The decline from 639,128 tons to 627,388 tons was entirely due to a 4% drop in output from smallholdings, which in turn was the direct result of lower rubber prices during 1956. In that year, estates accounted for 353,007 tons, against 352,916 tons—an increase of 91 tons, which might have been greater but for the "go-slow" action of tappers in May, 1956. The share of smallholders was 274,381 tons in 1956, as compared with 286,212 tons the year before. The output of special rubbers last year came to 8,581 tons, of which 361 tons were softened rubber (including rubber containing peptizers) and 37 tons chemically modified rubber (cyclized rubber and rubber powder); the remainder consisted of various unspecified, specially treated rubbers.

Revised figures for latex production put the total at 88,047 tons for 1956, of which 72,507 tons were centrifuged concentrate, 7,444 tons cream concentrate, and 8,096, other types, including Revertex and electro-creamed latex.

Malayan latex exports declined sharply last year, reflecting cutbacks in automobile production in the United States and consequent reduced demand for foam latex car upholstery, and also—though to a smaller degree—the tightening of regulations on installment buying in the United Kingdom, which hit the demand for foam rubber for furniture. The latex shipments in 1956, at 92,182 tons, were the lowest since 1953, and represented a decrease of 14.5% from the 1955 figure. The United States took 27,605 tons, 38.9% less than the year before, and the United Kingdom, 26,282 tons, or 15.6% less. On the other hand increased amounts went to Germany (9,320 tons, 31.2% more) France (6,027 tons, 21.4% more) and Japan (5,428 tons, 68% more).

It is thought that the relatively poor demand for latex from the United States might have caused some estates, notably in Johore, to switch from latex to sheet production. In any case, exports of ribbed smoked sheets in 1956 came to 627,222 tons, against 621,955 tons in 1955.

Rubber imports totaled 365,824 tons in 1956, not quite 1% above the 1955 amount and the highest since 1951. It is noted, however, that lower grades accounted for only 14% of the imports last year, against 15% in 1955 and 33.6% in 1954. Malayan exports of rubber in 1956 totaled 983,282 tons, against 994,179 tons in 1955. The United Kingdom was again Malaya's best customer, taking 232,407 tons; next came the United States with 155,228 tons; Western Germany with 81,735 tons; Japan, 74,529 tons; France, 72,178 tons; Italy, 56,098 tons; Canada, 34,623 tons; Australia, 30,478 tons. Of the South American countries, Argentina ranked first, with 20,224 tons. The direct purchases by Iron Curtain countries totaled 43,823 tons (Poland, 17,417 tons; Czechoslovakia, 13,200 tons; U.S.S.R. 12,791 tons; and Hungary 415 tons). Communist China's direct purchases from Malaya since the lifting of destinational control came to 8,707 tons.

According to figures published for 1957 so far, Malayan rubber exports amounted to 240,844 tons the first quarter of 1957. During this period, it may be added, there were repeated rumors that China was interested in buying considerable amounts of rubber (130,000 tons were mentioned earlier in the year, but the latest figure seems to be 100,000 tons) from southeast Asian countries. It appears that she did indeed contract for the purchase of 5,000 tons of rubber from Indonesia last March so that some Singapore rubber men figured that Malaya might be asked to supply up to half the total contemplated purchases, which led to brief flutters on the Singapore market. To early April, however, no orders from Red China had been received in Malaya.

New Planting Scheme

The Rubber Industry Replanting Board is considering a new plan to overcome the understandable reluctance of many smallholders to replant. This is a block planting scheme involving the opening up of new land on a cooperative estate basis, with maximum estate area of 250 acres. Participants will not have to cut down their existing holdings and replant until after their block planting areas have reached the tapping stage—normally in seven years. Up to eight acres of new land will be allotted, it is understood, and at least six acres of this must be planted with rubber; the remaining two acres may be planted with approved crops.

So far the replanting scheme for smallholders has been only moderately successful; of the 220,300 acres they were supposed to have replanted during 1953-1956, only about 58% has been replanted under the scheme and required the payment by government of $36,833,187 (Straits currency) in replanting grants.

The new plan, if properly backed and carried out may, incidentally, help curb a trend disturbing many who have the welfare of the country and the industry at heart; this is, the growing fragmentation of rubber estates.

Fragmentation of Estates

This development seems a recent one made possible by the anxiety of many estate owners to dispose of their land while they are able to do so at a profit. Speculators buy up these estates, generally moderate and smaller sized properties, then split them up into plots from three to ten or at most 15 acres, which they sell on mortgage at a high price. As the *Straits Times* recalls in a recent editorial on the subject, the International Bank Mission strongly warned against fragmentation, in its report on the economic development of Malaya, stating:

"Fragmentation leads to uneconomic holdings, concealed unemployment, increased indebtedness, reduced productivity . . . and in general has a demoralizing effect on a rural community."

The matter of fragmentation was brought to public notice when an estate of 1,389 acres in Pahang was recently broken up into lots of three to 15 acres and sold to 191 persons; the former workers were deprived of their jobs and had to seek work elsewhere. A report by the Labor Department reveals that probably at least a dozen other estates, ranging in size from 70 to 600 acres, situated in various parts of Malaya, have been bought up and similarly split.

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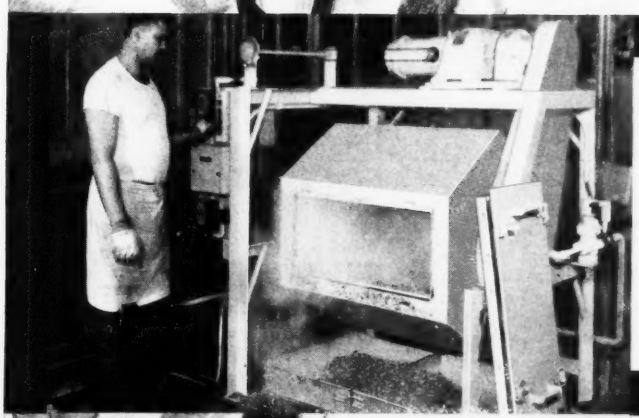

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was no cutthroat competition, he declared; both industries are essential to world economy, and the world could best be served by both industries working together. Natural rubber was recognized as the better product, for many purposes, and within reason, consumers were ready to pay more for it.

"At anything below 90 cents (Straits) for the top grades," Mr. Holiday was quoted as saying, "the product is by no means over-priced."

Japan

SBR Plant Planned by 1959

Plans for a semi-official company to produce synthetic rubber in Japan may soon be completed. According to a recent announcement by the Japanese Ministry of Trade, a "top level decision" is being awaited on whether the government should invest 1,500,000,000 yen (about $4,200,000) for half the capital of the new company. The Furukawa financial group, which had its own plans for synthetic rubber production, has been persuaded to withdraw opposition to the idea of a semi-official company. The Finance Ministry had suggested that long-term loans from commercial banks at low interest and tax reliefs should be sufficient to replace the proposed government investment.

As matters now stand, the 1,500,000,000 yen for the second half of the capital of the new company would be supplied by private industrial groups. In addition, the company would receive loans totaling about $21,000,000 from the Japan Development Bank, during 1957 and 1958, to cover installation costs.

Production is expected to include 27,000 tons of styrene-butadine rubber (SBR) and 3,000 tons of latex in 1959 and is to be raised to 40,000 tons of SBR and 5,000 tons of latex in 1962. Estimates of Japan's requirements of synthetic rubber run to at least 45,000 tons by 1960.

Export Business Increasing In Rubber and Other Lines

According to reports from Tokyo, the Japanese have arranged to import their total rubber requirements from 14 shippers in Malaya and Singapore under new contract terms providing, among the rest, for commercial arbitration in Japan instead of in Singapore. An institution to be set up by the Japanese Rubber Importers' Association will handle arbitration on imports of Malayan rubber into Japan and not, as has heretofore, by an arbitration body appointed by the Singapore Chamber of Commerce.

Japan's efforts to expand her market for automobile tires and tubes in Asian countries especially, are obviously meeting with much success, as the value of export contracts made in 1956 reveal. The unprecedented total of $18,483,457, double the 1955 figure, could be attained largely as a result of the interest shown in Japanese tires by these nations. The leading participants in this business were: Burma—$2,483,564; South Vietnam, $1,407,489; Philippines—$1,384,804; Hongkong—$1,329,791; Saudi Arabia, $1,235,333; Thailand—$1,121,890; Indonesia —$1,002,814; Nationalist China—$883,962; Iran—$864,537; Bolivia—$835,681; Singapore—$745,654.

Following Japan's Floating Fair, which was on view in Singapore for two days last February, several Malayan firms showed interest in Japanese buses and trucks. This has led to a strong campaign to push these items in Malaya, as well as passenger cars. Japan's production of these lines has developed remarkably in recent years, and she seems to be able to offer competitive prices. At present her main outlets for motor vehicles are: Siam, Okinawa, Formosa, and South America, including Argentina and Brazil. In addition to domestic brands, Hillman, Austin, and Renault cars are now also being made.

According to figures published by the Secretariat of the International Rubber Study Group, Japan imported 112,500 long tons of rubber in 1956, including 8,250 long tons of synthetic rubber, which represents a substantial increase over the 1955 total of 92,000 tons, including 4,500 tons of synthetic rubber. Trade circles expect a further rise in the requirements in the current year.

Great Britain

Polymer Corp. Lecture

At the meeting on November 28, 1956, of the London Section of the Institution of the Rubber Industry, S. C. Kilbank delivered this year's Polymer Corporation lecture, on "The Mixing Characteristics and Use of Improved Oil-Extended Rubber."

Mr. Kilbank discussed in detail the methods which led to the development of the improved polymer and thereby to the elimination of most of the difficulties encountered in large-scale use of the earlier oil-extended styrene-butadiene rubbers. He compared the mixing characteristics of the former oil-extended rubber Polysar Krynol and of the improved Krynol 651 and Polysar Krylene, using a simple laboratory dispersibility test for predicting the mixing behavior of the polymers on a factory scale. He then dealt with applications of the new polymer, particularly for tires where, he said, laboratory and road tests had given very favorable results.

Hancock Medal to Sutton

The 36 years of distinguished service given to the rubber industry by Sidney David Sutton have been recognized by the Institution of the Rubber Industry, which presented him with its Hancock Medal for 1956.

Mr. Sutton entered the laboratories of Dr. P. Schidrowitz about 1920 and worked with him on the development of vulcanized latex. In 1926 the Medalist left to join the newly formed Veedip, Ltd., becoming a director of the firm in 1949 and general manager in 1950. He has been active in various organizations furthering the industrial and technological interests of the rubber industry; since its inception in 1948 he has been on the board of governors of the National College of Rubber Technology as a representative of the IRI. He also has a number of published papers to his credit and has taken out eight British patents on latex.

Ceylon

1957 Rubber-Rice Details

The rubber-for-rice agreement between Ceylon and China has recently been signed for 1957, the final year of the five-year barter deal between the two countries. Surprisingly enough, in view of the fact that China now can choose her source of supply, she has again undertaken to pay a premium—if somewhat lower than last year—over the Singapore average market price for one month. Under the terms of the new contract, China will buy 50,000 metric tons of rubber at a base price of 27d. per pound. The premiums to be paid are: 4½d. per pound when the Singapore fob. price is between 22½ and 28d.; 3d., when that price is between 28d. and 35d.; 2½d., when it is between 35d. and 40d., and 1d. when it is over 40d.

Ceylon is to get 270,000 metric tons of rice at £30. 7s. 6d., fob. China ports, exclusive of bags, per metric tons. The price for rice is under that agreed on for 1956.

South Korea

Rubber Industry Expanding

In line with South Korea's industrialization program, the manufacture of rubber goods is undergoing considerable expansion. Recently the production of automobile tires has been added to footwear and bicycle tires as important locally produced lines, and the growing activity in these fields is reflected in the sharply mounting purchases of rubber from Malaya. In the first 10 months of 1956, South Korea bought 8,195 tons of rubber, against 3,296 tons for the same period in 1955; a further increase is expected this year.

The automobile tire factory recently started by Eun Sung Industrial Co., Ltd., Seoul, alone intends to buy 500 tons of rubber monthly as soon as it begins working to capacity. This company is also a large manufacturer of rubber footwear, with present output of 20,000 pairs daily, including all types. At present only 1% of total production is exported, to Hong Kong, which acts as redistribution center, but the company plans to export footwear to Malaya also before long.

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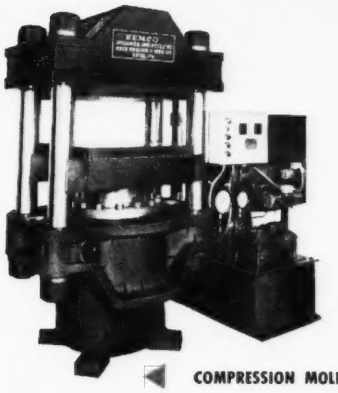

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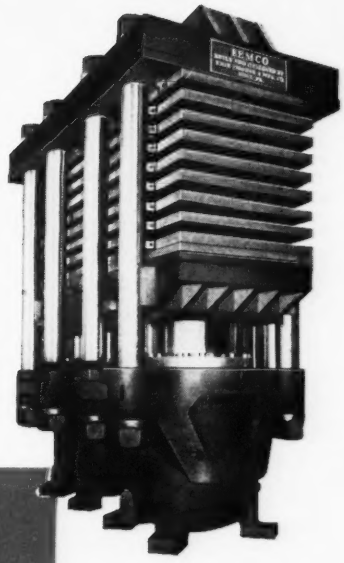

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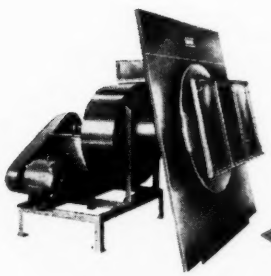

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Germany

Houdry Butadiene Process Installation Changes

New developments in the planned production of synthetic rubber at Bunawerke Huls, are reported by *Kautschuk und Gummi*.[1] It is recalled that at the conference of the Deutsche Kautschuk Gesellschaft, in Hamburg, June, 1956, P. Baumann, board chairman of Chemische Werke Huls, in his discussion on synthetic rubber, stated his opinion that it had not yet been determined whether *cis*- and *trans*-isomers had the same significance for polybutadiene as for polyisoprene. According to our contemporary, he now adds to his statement that research at Chemische Werke Huls carried out during 1955 (which led to applications for new patents) as well as recent literature has revealed that poly-*cis*-1, 4-butadiene resembles rubber; whereas the 1-*trans* polymer is a thermoplastic.

Construction on the synthetic rubber works of Bunawerke Huls, G. m. b. H., is progressing favorably, and the company hopes to start producing in the Summer of 1958. Certain changes are to be made in connection with the installation of equipment for the Houdry butadiene process which, as is known, is considered the most suitable for Huls. It had originally been planned to install five dehydration reactors in parallel and arranged in one row, similar to the arrangement in American establishements. It has been decided, however, that it would be more efficient for Huls to use six reactors working in parallel, but arranged in two rows with three reactors in each so that while one row is disconnected for repairs or contact alternation, the other can continue to operate; the six reactors are to be connected in such a way as to permit continuous flow.

The new arrangement is said to offer several advantages: the time for a cycle is reduced to 15 minutes, which allows more time for the alternation from the production to the regeneration cycle and *vice versa*, thereby permitting surer removal of oxygen from the contact layer as well as better recovery of remaining hydrocarbons from the contact layer; a closer approach to ideal isothermal conditions is made possible; finally, a reduced reaction period leads to an increased yield of butadiene.

No special changes seem to be contemplated in other sections.

[1] Mar., 1957, p. 53.

Synthetic Rubber Consumption in Germany

The consumption of synthetic rubber in West Germany has been increasing rapidly since 1953, when 11,130 tons were used; the following year saw a rise to 15,617 tons; in 1955, to 24,216 tons; while the total for 1956 is put at 35,000 tons, or about 22% of the country's consumption of new rubber last year.

The new Buna Works at Huls is expected to be producing 45,000 tons of cold rubber by 1959, and other German factories will probably be making a further 15,000 tons of other types of synthetic rubbers by that time, so that from 1959 on total synthetic rubber production here may exceed 60,000 tons a year.

Kautschuk und Gummi, in considering this situation, points out that according to the present trend, total synthetic rubber consumption in West Germany would barely reach 50,000 tons in 1959 so that there would be a surplus of at least 10,000 tons of synthetic rubber which would have to be disposed of either by increasing the proportion of synthetic rubber to 35% of total new rubber consumption, or by exporting. Both solutions present problems; efforts to build up an export business in synthetic rubber might confront German consumers with the difficulty that their own needs would be expanding considerably just at the time when domestic producers had to fulfill large foreign contracts.

Indonesia

In order to obtain further statistical data on lower-grade rubber from East Coast Sumatra, an investigation was undertaken at the AVROS Experiment Station, Medan, by K. F. Heinisch, C. Vervloet, and D. Doup,[1] on the variation in dirt content of Thin Brown Crepe from three Amsterdam Rubber Plantation Co. estates.

Dirt determinations were carried out for 18 months on Browns 1-X, 2-X, and 3-X, parallel with technical classification tests. The procedure was to take corner samples on 2-5 days a week from 10% of the packed bales, for determining rate of cure. Then one bulk sample was prepared from which 100 grams were cut off and treated for dirt content examination.

Results showed little variation in the average values for similar grades from the different estates, but the differences in standard deviation were larger for some estates as compared with others. Rated according to the provisional classification scheme (under which the maximum harmful dirt ranges from 0 to 0.05% for Class I; from 0.05 to 0.15% for Class II; 0.15 to 0.30% for Class III; and rubber with a harmful dirt content over 0.30% is considered dirty, unclassifiable rubber) well over 97% of grade 1-X and 90% of grade 2-X, fall under classes I and II, respectively; while upwards of 84% of grade 3-X came under Classes II and III. The majority of the samples proved to have a low dirt content; a small percentage of samples with high dirt content was responsible for the considerable variation. Well over 80% of the samples were found to have below-average dirt content.

In cooperation with the Soc. Financière des Caoutchoucs, Service Technique, the possibility was studied of reducing the dirt content by preliminary treatment of lumps and scraps in a Werner & Pfleiderer type of washer, for 15 minutes. Results indicated that both harmful dirt and total dirt contents can be reduced by about one half in the case of 2-X and 3-X Browns, but harmful dirt content of 1-X Brown (325 mesh) remained unchanged.

[1] *Arch. Rubber Cult.*, 33, 2, 241 (1956).

India

India's expanding rubber manufacturing industry has for some time brought up the question how best to meet the growing need of supplies. Of the 207,240 acres planted to rubber in South India, almost 80% consists of low-yielding, unselected material, planted from 1902 on; nearly 100,000 acres were planted before 1938. In 1955, total production of natural rubber here came to 22,481 tons, against total consumption of 27,543 tons, leaving a substantial deficit to be made up by imports. Final figures for 1956 consumption are expected to be about 30,000 tons.

The government is said to be considering plans to eliminate dependence on foreign imports both by replanting obsolete areas with high-yielding modern stock, and producing synthetic rubber. A report on a replanting scheme has apparently already been made, and last summer the Minister for Heavy Industries announced that a team of foreign experts was preparing a report on the production of synthetic rubber; one of the raw materials considered is alcohol from molasses.

Italy

In the so-called "girdled" tire, recently launched by Pirelli, the cords of the carcass, instead of forming an angle of 45 degrees with the circumference of the tire, as is usual, run at an angle of 90 degrees, that is, around the cross-section. The whole is held together by plies in which the cords are parallel to the circumferential cords.

Tests with passenger-car and truck tires (9.00—20) were carried out to compare the deformation of girdled and ordinary tires as a function of inflation pressure and load, on smooth roads and also over an obstacle.

The tire marks showed that there is a greater tendency to circumferential flattening, but less transversal flattening in the case of the girdled tire than of the usual kind. The distribution of local pressures on the surface of contact appears to be more uniform in the case of the new tire which suggests the advantage of less wear on road surfaces.

Netherlands

Rubber Stichting, Delft, has discontinued its organ, *Rubber*, with the December, 1956, issue. *Rubber* first appeared in January, 1938; publication was stopped during the German occupation of the Netherlands in World War II, but was resumed soon after the end of hostilities.

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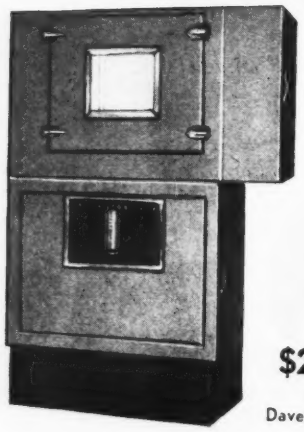

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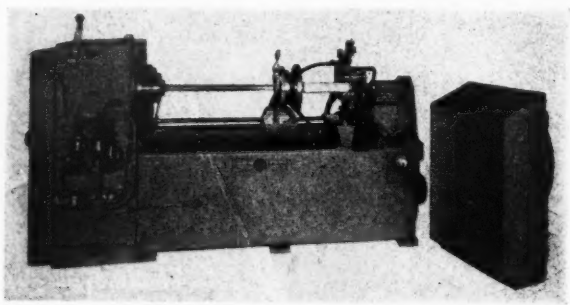
A new semi-automatic tape cutter which makes individual width cuts from full rolls of vinyl and other plastic, cloth, cellophane, and similar type of tapes has been announced by Black Rock Mfg. Co., Bridgeport, Conn. The unit handles material up to 37-inch maximum web, maximum wall thickness up to 2½ inches, and to a maximum paper core I.D. of 3½ inches. This cutter will also handle a maximum O.D. of eight inches. Variable widths up to 1¾ inches can be cut, and each width of cut requires a separate pair of change gears.

According to the company, once the machine has been set up for a particular size of stock, the only manual operations required are the installation of the tube of material to be cut on to the mandrel and the removal of the scrap end after the full length has been cut. All other operations are controlled from the console-type panel.

The tape cutter features a wet-type of gear box, solenoid operated air valve on tailstock, core ejector mechanism, brake to stop automatically the blade in loading position, quick return of the carriage to the starting position, adjustable speed on the knife drive through manually controlled vari-pitch pulley, and forced feed cutting lubricating system.

The unit is 110 inches long, 52 inches high, and 36 inches wide. The control panel is about 36 inches long, 18 inches wide, and 44 inches high.



Black Rock's semi-automatic tape cutter

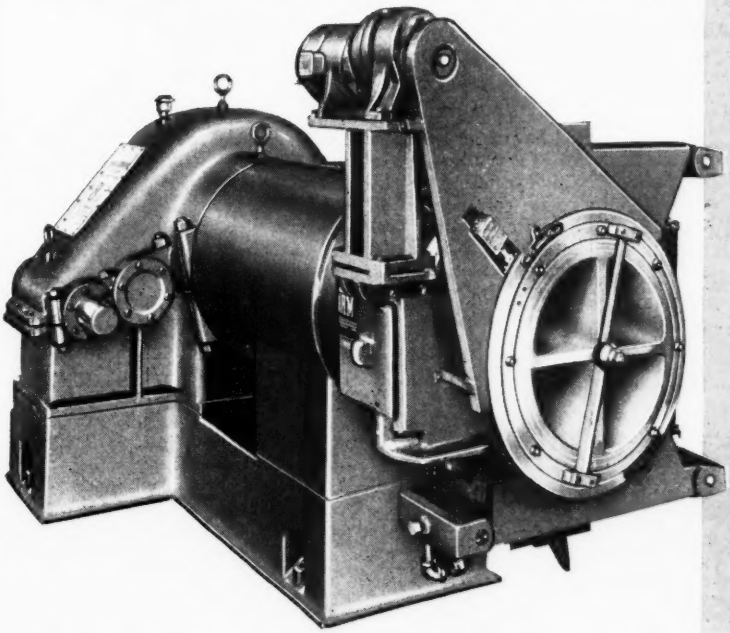
Atmospheric Ozone Controller

An atmosphere ozone controller that actuates an alarm when the ozone concentration exceeds a preset level has been announced by G. F. Bush Associates, Princeton, N. J. Called GFB Ozone Detectalarm Model A.1, it will automatically produce an alarm, such as a light, buzzer, or bell, and will actuate exhausting apparatus for the protection of personnel and materials when the ozone concentration of the surrounding atmosphere exceeds a preset level estimated to be dangerous. Concentrations of 10 parts of ozone per hundred million parts of atmosphere are now detected in industrial and research service.

In the Detectalarm, the very small current produced at electrodes by iodine in the ozone reaction is used to introduce the small flow of titrant which is present in flow rate and normality for a required alarm concentration. If the detected ozone concentration exceeds the alarm concentration, so that the titrant is unable to remove the iodine and current, the excess current produces the alarm signal.

Weighing about 15 pounds, the device is 15 by 12 by 12 inches, plugs into an electrical outlet and operates on a 115 vac. single-phase, 60-cycle current. The required solution is changed about every one to three days. A recorder unit can be supplied with the device.

These *Exclusive* features make NRM RUBBER STRAINERS the most time-saving, cost-cutting strainer in the industry

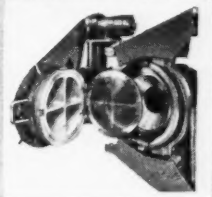


Advanced design and engineering features like these are only a few of the many reasons which have made NRM Rubber Strainers the "standard" of the industry. Plant owners appreciate, too, their space-saving compactness, installation ease and operating simplicity.

Our new data bulletin on NRM Rubber Strainers fully explains design, construction and operating features and advantages. A postcard brings it to you without delay. See for yourself why rubber goods manufacturers the world over rely on NRM Strainers for trouble-free *sustained* high production, at minimum maintenance cost.

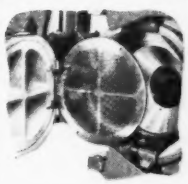
QUICK-OPENING HEADS

Merely flip a valve and air-operated clamps are *instantly* released and the NRM head can be swung open. This compares with 5 to 10 minutes or longer required to open other types of heads. Screen-changing time is reduced to an absolute minimum.



HINGED STRAINER PLATES

NRM Strainer Plates are hinged directly on the head assembly to provide quick access to head interiors. Cleaning of both plate and the head cavities is thus made easier and faster.



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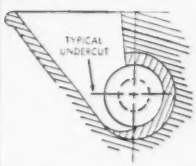
Offset and undercut, NRM Feed Boxes provide uniform, maximum stuffing of the cylinder. Whether hand or strip fed, the undercut enables the screw to "pull" steadily, preventing voids in the cylinder and providing maximum thru-put.



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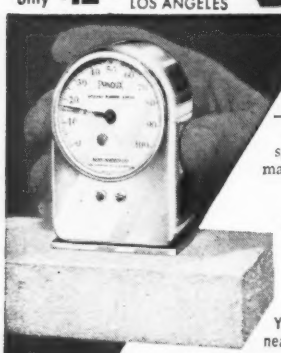

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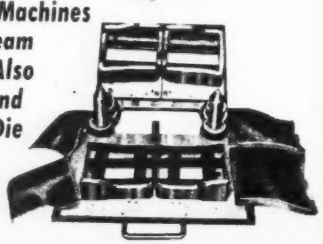

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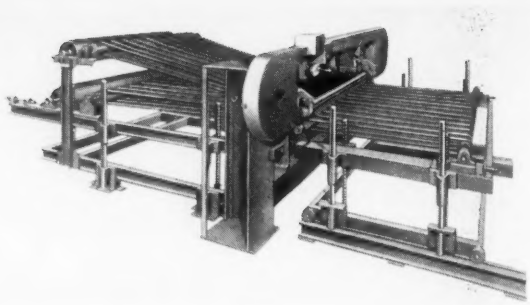


FEMCO convolution machine

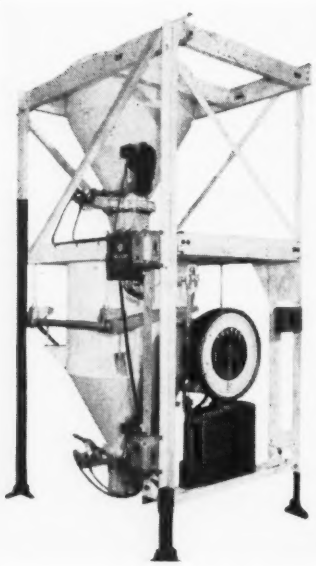
Multi-Functional Convolution Machine

A new convolution machine that will make convoluted or irregular shaped cuts of polyurethane and polyvinyl foam stock, handling slabs or rolls, has been announced by Falls Engineering & Machine Co., Cuyahoga Falls, O.

The unit will level the material and also split it into sheets as thin as ⅛-inch from a piece of stock with a maximum depth of 15 inches. The machine was designed to do the work of three other Falls Engineering machines: the cushion cutter, foam rubber splitter, and the single-head conveyorized slab cutter.

The convolution machine is 84 inches wide, 18 feet long, and handles slabs nine feet in length, taking longer slabs when idler rolls are added. The cutting bed consists of two power-driven strip-type conveyor belts, similar to those on the company's conveyorized slab cutter. A two-inch-wide straight-edge blade which sharpens intermittently and semi-automatically is used to make the cuts.

Bulk Weigher with Remote Totaling



Toledo automatic bulk weigher

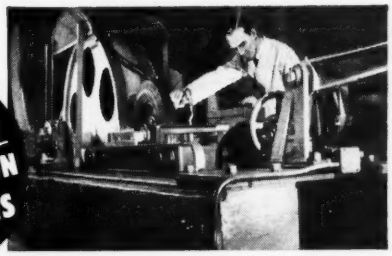
A new weigher that remotely prints and totals net weight records of bulk materials has been announced by Toledo Scale Co., Toledo, O. The unit is said to have an individual draft capacity of 1,000 pounds. It also features automatic compensation for material remaining in the hopper after the bulk of the material has been discharged.

The Toledo weigher has a suspension-type hopper scale from which is mounted a weigh hopper. Above the weigh hopper is a surge hopper that receives the material and dumps it into the weigh hopper. Both hoppers are equipped with pneumatically operated discharge gates. The scale-indicating mechanism is equipped with a cutoff device to stop the flow of material from the surge hopper into the weigh hopper at a preset cutoff position.

A direct digital electro-mechanical converter is included on the scale that transforms weights into electrical signals which are transmitted to an electric adding machine. The adding machine may be remotely located. Sub-totals or total can be taken when desired.

The weigher is also provided with an operating station that can be mounted near the scale or in a remote office area. This station includes switches, pilot lights, and a predetermined counter for setting the number of drafts to be delivered.

INTERNATIONAL TECHNICAL ASSISTANCE



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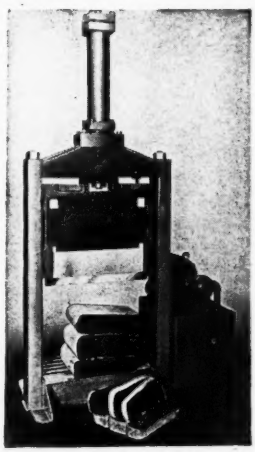

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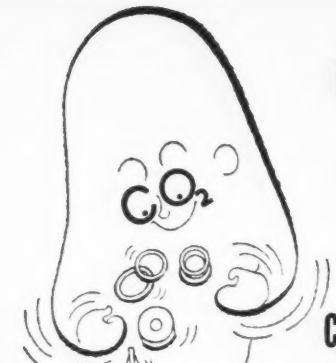

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NEW MATERIALS

American Cyanamid Accelerator 2-MT

A special-purpose accelerator, 2-mercaptothiazoline, which is said to contribute to vulcanizates such properties as higher modulus, increased age resistance, retention of tensile strength and tear resistance at elevated temperatures, greater resistance to flex-cracking, and substantially reduced heat build-up, has been introduced by the rubber chemicals department of American Cyanamid Co., Bound Brook, N. J. A creamy white powder, not considered hazardously toxic in normal industrial use, 2-MT is adapted particularly to compounding rubber for tires, belts, mechanical goods, and for other applications requiring good aging properties and retained resilience.

According to the company, extensive tests to natural rubber channel black tread or carcass stocks show 2-MT imparts good physical properties. When used with cold SBR camelback stocks, this accelerator has been found to increase mileage. The superior heat resistance of 2-MT in latex compounding for rug backings and latex threads for garments satisfies these demanding applications, a company report indicates.

The new accelerator is said to be more active than MBT or MBTS and remains active and fast curing above 250° F. It is activated by aldehyde amines, salicylic acid, guanidines, thiurams, and dithiocarbamates. Specific gravity of 2-MT is 1.54, and its melting point is not lower than 101° C. Storage stability is claimed to be excellent.

Du Pont Glycidyl Methacrylate

Glycidyl methacrylate monomer, the 2,3-epoxy propyl ester of methacrylic acid, is being made available in pilot-plant quantities by E. I. du Pont de Nemours & Co., Inc., finishes division, Wilmington, Del., for the development of a wide range of possible end-uses. Suggested applications of the monomer, or its homopolymer and copolymers, include the following: stabilizers for polyvinyl chloride, thermosetting vinyl polymers, anti-static agents for plastics and synthetic fibers, lubricating oil additives, water or organic soluble polymeric phosphates, adhesives, surface active agents, in the preparation of alkyd resins and as a route to styrenated or vinyl alkyds, to provide vulcanizing sites in synthetic rubber, to provide cross-linking sites in vinyl polymers, and to prepare ion-exchange resins.

The monomer, being marketed as CP-105 Glycidyl Methacrylate, has added to it 20 PPM of hydroquinone monomethyl ether inhibitor to prevent polymerization during storage and transit. Most end-uses do not require the removal of the inhibitor.

CP-105 is miscible with organic solvents and immiscible with water. It shows no change in viscosity and only slight darkening after two years' storage in glassware at 25° C. It shows an appreciable viscosity increase after six weeks' storage at 60° C. The company suggests that drums of it should not be stored out of doors in direct sunlight.

Some reported physical properties of CP-105 Glycidyl Methacrylate are as follows:

Specific gravity @ 25° C.	1.073
Refractive index @ 25° C.	1.4482
Viscosity @ 25° C., centistokes	2.0
Color, Parlin scale	4 max.
Boiling point, 10 mm. Hg.	75° C. (approx.)
Vapor pressure @ 25° C.	0.55 mm. Hg.
Flash point, Tag open cup	183° F.
Saponification No.	390–400

A technical bulletin describing chemical reactions of CP-105 is available from the company on request.

Carpet Yarn Latex Splicing Compound

A latex splicing compound for joining carpet yarns made of nylon, acetate, acrilan, viscose, cotton, or wool has been announced by Alco Oil & Chemical Corp., Philadelphia, Pa. Called Vulcanol adhesive AL-1005, it is said to set uniformly and quickly, but not so rapidly as to interfere with the operator making a strong, well-formed yarn joint. The new adhesive was developed, the company says, especially for use with the newer, non-absorbing synthetic fibers which are usually difficult to splice because of their inability to destabilize adequately the older types of latex compounds by withdrawing water.

Sold in two parts, AL-1005 must be mixed just prior to use in a wet weight ratio of 85 parts of one component to 16 parts of the other. Under summertime mill temperatures, the mixed material is stable for about eight hours, thus allowing the preparation of a quantity sufficient to meet the requirements of one plant shift.

Splices made with the new adhesive need not be more than 3/8-inch in length or of a diameter exceeding that of the yarn itself. The splices are strong enough to withstand the tensions of various winding, creeling, and tufting operations, according to the company.

Pliovic S70

A new medium viscosity, general-purpose, polyvinyl chloride resin for such uses as calendered film and sheeting has been placed on the market by The Goodyear Tire & Rubber Co., chemical division, Akron, O. Designated Pliovic S70, it is said to provide a large surface area through its fine particles, thus permitting effective plasticizer adsorption. This material is intended for use where maximum flow, sparkling clarity, and moderate processing temperatures are required—in molding, extrusion, or calendering applications.

Such applications include, according to the company, both clear and opaque calendered film and sheeting, homogeneous and laminated flooring, extruded cove base molding, injection molded items, molded phonograph records, high chemical-resistant rigids, and pigment masterbatches. Blending Pliovic S70 with higher molecular weight resins will improve its plastic flow, as well as calender bank action and heat-seal properties of calendered stocks, and will lead to reduction of processing temperatures.

A fine white powder with an average particle size of 40 microns, Pliovic S70 has an inherent viscosity of 0.86, a specific gravity of 1.40, and a bulk density of 44 pounds per cubic foot, Goodyear reports.

Tech Book Fact 57-74, detailing this new material, is available from Goodyear Tire & Rubber Co.'s chemical division, plastics department.

Polyethylene Mold Release Agent

A polyethylene mold release agent for use in the production of rubber and plastic molded products has been introduced by Barrett Division, Allied Chemical & Dye Corp., New York, N. Y. Colled "Poly-Lease 77," it consists of a solution of low-molecular weight polyethylene in a mixed solvent system and is supplied in aerosol form, using Genetron as the propellant. The parting agent is said to be particularly effective with such thermosetting plastic and vulcanized compounds as phenolic, phenolic rubber, melamine, urea, polyester, alkyd, and rubber. "Poly-Lease 77" can also be used with casting or potting of epoxy, phenolic, furane, and polyester resins.

Silastic 916 for Wire Insulation

A silicone rubber that combines high strength with the thermal stability and good electrical characteristics typical of silicone rubbers has been announced by Dow Corning Corp., Midland, Mich. Designated Silastic 916, it is said to be ideal for wire

(*Continued on page 293*)

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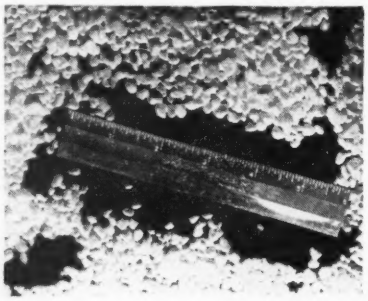

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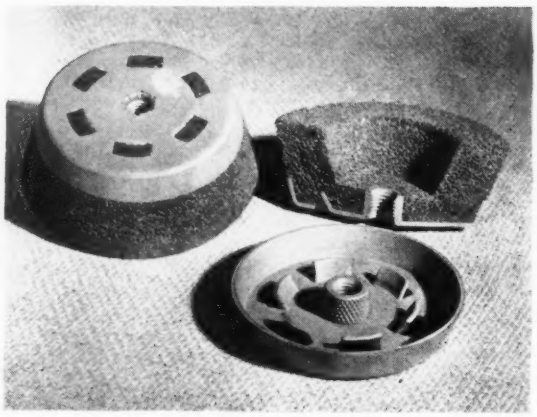


Safety Back Flared Cup

Reinforced Flared Cup Grinding Wheel

A new type of reinforced flared cup grinding wheel is being offered by Raybestos-Manhattan, Inc., Manhattan Rubber Division, Passaic, N. J. Called Safety Back Flared Cup, the portable grinding wheel has an overall steel backing, a threaded steel insert for secure mounting, and a resin or rubber bonded abrasive. The steel backing, which is disposable, covers no more of the wheel than a revolving cup guard, does not interfere with the operator's maneuvering, and does not require adjustment, as do skirt guards.

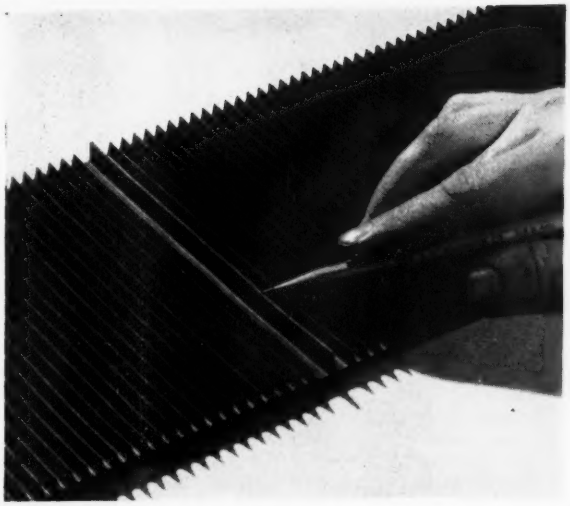
Armstrong Vinyl Wall Tile

A new type of industrial vinyl wall covering, said to be resistant to soiling, staining, fading, scuffing, moisture, and fire, has been announced by Armstrong Cork Co., Lancaster, Pa. Called Vinyl Wall Tile, it is made of vinyl plastic and asbestos fiber and is flexible enough to curve around inside and outside corners of walls, according to the company. Applied with adhesive, the wall covering can be formed to sharp angles by heating with a blowtorch. Available in nine- by nine-inch tiles, it is currently being produced in black, white, yellow, green, gray, pink, beige, turquoise, and cork colors. The tile is particularly suited to plant locker and rest rooms, Armstrong says.

BFG Ribbed Package Conveyor

A new ribbed package conveyor belt designed for steep-angle conveyor operations in stores, factories, warehouses, and shipping rooms that handle both light and heavy merchandise packages has been developed by B. F. Goodrich Industrial Products Co., Akron, O. Called Griptite, the belt has a series of inverted V-shaped ribs that grip cartons in either incline or decline operations. Extra protection for holding extremely lightweight packages in place is provided by raised ribs or cleats spaced 18 inches apart. The standard ribs are ¼-inch high and are spaced four to the inch. The raised ribs are ⅜-inch high.

According to the company, the ribs are molded with a tough, flexible, long-wearing rubber compound. The carcass is made



Griptite package conveyor belt. Pencil points to raised rib for holding lightweight packages

of a lightweight fabric, especially suited for the small pulleys normally used on package conveyor equipment. As the belt travels around the pulleys, the ribs fan out, releasing any spillage in the grooves.

Baby Items of Vinyl Material

Baby Set, a packaged assortment of waterproof items for babies made with B. F. Goodrich Chemical Co.'s Geon vinyl resin, has been introduced by Rand Rubber Co., Brooklyn, N. Y. The items, consisting of a selection of baby pants in small to large sizes, flannelette sheeting in three different sizes, an air-filled quilted rubber pad, waterproof bibs, and a diaper bag with pockets for both wet and dry diapers, are marketed in a decorated three-drawer cabinet. The vinyl material, dubbed Breeth-ees, is said to permit the passage of water vapor, but not water, through it.

Silastic 916

(Continued from page 291)

and cable insulation, as well as such heat-stable resilient parts or components as oven-door gaskets, aircraft door seals, and O-rings.

According to the company, Silastic 916 does not nerve-up on shelf aging, requires little milling even after long-term storage, and is suitable for molding, laminating, extruding, or calendering. It can be hot-air vulcanized and in the unvulcanized state remains firm and minimizes possible distortion of extruded shapes prior to curing.

Some typical properties of Silastic 916, as reported by Dow Corning, are as follows:

Specific gravity @ 25° C	1.25
Hardness, Shore A scale	54
Tensile strength, psi	1500
Elongation, %	550
Tear strength, lb. in.	180
Compression set, %, 22 hrs. @ 300° F.	25
Brittle point, °F.	−178
Stiffening point, °F.	−166
Electric strength, volts/mil	450
Dielectric constant, @ 10^2 cycles	3.01
10^6 cycles	2.99
Power factor, @ 10^2 cycles	0.0015
10^6 cycles	0.003

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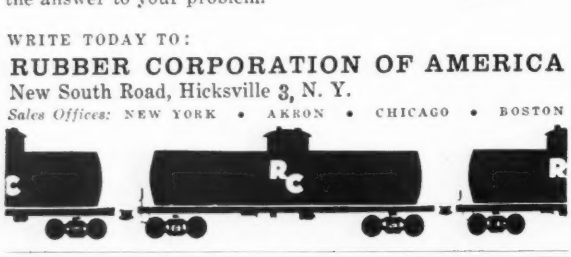

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TECHNICAL BOOKS

BOOK REVIEWS

"Manufacturing Methods and Processes." Arthur C. Ansley. Chilton Co., Philadelphia, Pa. Cloth cover, 6 by 9 inches, 576 pages. Price, $12.50.

This work represents a summary of the newest developments in manufacturing methods, their end-products, and economics for the executive, purchasing agent, production man and engineer. Intended for anyone associated with design or production in the manufacturing industries, the book describes methods and equipment used in each of the processes discussed, emphasizing the type of parts made by each process, chief applications, and cost. More than 450 photographs supplement the text.

Among the processes covered are casting, forging and extrusion, sintering, machining, heat treating and case hardening, plastics and their fabrication, adhesive bonding, finishing, inspection and gaging, and automation. Of specific interest to workers in the rubber industry are the brief discussions of rubber in the making of adhesives and in dies.

Some of the companies credited with providing assistance and photographs for this book are Dow-Corning Corp., E. I. du Pont de Nemours & Co., Inc., B. F. Goodrich Chemical Co., B. F. Goodrich Co., Koppers Co., Minnesota Mining & Mfg. Co., O'Sullivan Rubber Corp., Rubber & Asbestos Corp., F. J. Stokes Machine Co., Sun Oil Co., Timken Roller Bearing Co., and R. D. Wood Co.

"Documentation in Action." Edited by Jesse H. Shera, Allen Kent, and James W. Perry. Reinhold Publishing Corp., New York, N. Y. Cloth cover, 6 by 9¼ inches, 486 pages. Price, $10.

This book is a record of the proceedings of the 1956 Western Reserve Conference on the Practical Utilization of Recorded Knowledge. It constitutes a review of the science and art of effectively organizing and utilizing recorded information, bringing together for what is said to be the first time the many diverse documentation interests.

Recent advances are summarized and evaluated with particular attention to systems, equipment for making information available as needed, use of recorded information in research and in decision-making and education for librarianship. The papers presented were authored by prominent research managers, operations researchers, equipment designers, scientists, lawyers, government administrators, librarians, documentalists, publishers, and educators. The discussions are systematic and scholarly and cover all of the aspects of this many-faceted field.

NEW PUBLICATIONS

"Dipac vs. Other Rubber Accelerators." Pennsylvania Salt Mfg. Co., industrial division, Philadelphia, Pa. 12 pages. A comparison of the performance of the company's delayed-action sulfenamide accelerator with other rubber accelerators in six natural and synthetic rubber recipes is contained in this booklet.

"Sunolite Anti-Sunchecking Waxes." Bulletin 57-1. Witco Chemical Co., New York, N. Y. 20 pages. Witco's anti-sunchecking waxes are described in this illustrated booklet, together with an outline of wax testing procedures and an evaluation of waxes in rubber compounds for the automotive, mechanical goods, footwear, and other industries.

"Longer Belt Life for Your V-Belt Drives." Bulletin 20X6234C. Allis-Chalmers Mfg. Co., Milwaukee, Wis. 12 pages. Selection and care of V-belts are subjects of this illustrated publication. Seven steps for the correct installation of belts are listed, as well as the eight most common causes of V-belt deterioration.

"Diethylene Glycol and Triethylene Glycol." F-8085. Carbide & Carbon Chemicals Co., New York, N. Y. 16 pages. Data on the physical and physiological properties, specifications, constant-boiling mixtures, and applications of the company's diethylene glycol and triethylene glycol, intermediates for resins and plasticizers, are presented in this booklet.

"Stan-Tone Dry Colors." Bulletin #02-175-4-3-57. Harwick Standard Chemical Co., Akron, O. 4 pages. The company's organic and inorganic dry colors for the rubber and vinyl industries are listed in this bulletin, together with summarized performance data.

"Hycar Technical Newsletter." Vol. VI, No. 1, February, 1957. B. F. Goodrich Chemical Co., Cleveland, O. 8 pages. Specification compounding of Hycar polymers is the subject of this issue of the Newsletter. Included are recipes and test data covering Bendix-Westinghouse Specification 1036-M, Military Specification MIL-G-1086A, Allison Proposed Specification 22619, Automotive Specification No. 69, and Nash-Kelvinator Specification M-2744.

"Literature Kit." Stillman Rubber Co., Culver City, Calif. Included in this kit are the company's product catalog, a new price list on its military-approved O-rings, and a description of Stillman's new rubber-to-metal bonding process, "The Permadizing Story."

"Series 40 Impulse Steam Traps." Bulletin T-1746 (57A). Yarnall-Waring Co., Philadelphia, Pa. 4 pages. Specifications, applications, and capacities of the firm's impulse steam traps for heavy condensate loads requiring extra-high capacity traps are reported in this illustrated brochure.

"Organic Research Chemicals." Peninsular ChemResearch, Inc., Gainesville, Fla. 28 pages. This is a price list of the company's wide range of organic chemicals, including allyl monomers, amines, epoxy compounds, fluorine compounds, isocyanates, organic intermediates, phosphorus compounds, quaternary ammonium compounds, and silanes.

"Symposium on Corona." ASTM Special Technical Publication 198. American Society for Testing Materials, Philadelphia, Pa. Paper cover, 6 by 9 inches, 32 pages. Price, $1.25. Papers presented at a symposium held at the November 18, 1955, meeting of ASTM Committee D-9 on electrical insulating materials in Cincinnati, O., are published here.

"Low-Cost Production of Polyurethane Plastic Foams." Gabriel Williams Co., Inc., Freeport, L. I., N. Y. 4 pages. Specifications, operation, and advantages of various models of the Klauder Williams foam machine for producing polyurethane foams are contained in this illustrated folder.

"'dag' Dispersions for Industry." January, 1957. Acheson Colloids Co., Port Huron, Mich. 4 pages. This is a new edition of the company's bulletin covering the physical properties and uses of its products. This listing contains 44 colloidal and semi-colloidal dispersions of graphite, molybdenum disulfide, mica, vermiculite, zinc oxide, acetylene black, copper, and glass for application in a variety of industries.

"Synpol." March, 1957. Texas-U. S. Chemical Co., New York, N. Y. 18 pages. Properties and uses of the company's complete line of butadiene-styrene rubbers are reported on in this illustrated booklet. Fabricating information is also given.

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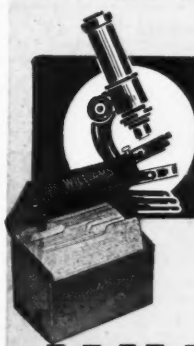

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Publications of The Goodyear Tire & Rubber Co., Inc., Akron, O.:

"Plioflex 1712." Tech-Book Facts 56-353. 1 page. Typical properties of the company's Plioflex 1712, a cold, oil-extended styrene rubber, appear on this data sheet, together with a test vulcanizate recipe and its test data. Suggested uses for the rubber are included.

"Plioflex 1500." Tech-Book Facts 56-354. 1 page. Data on Plioflex 1500, a cold, general-purpose non-extended styrene rubber, including physical properties, test vulcanizate recipe and its test data, and suggested uses are contained in this data sheet.

Publications of Claremont Pigment Dispersion Corp., Roslyn Heights, L. I., N. Y.

"'4000' Series." Technical Bulletin No. 160. 3 pages. The use of the company's color paste concentrates for coloring polyester resins is considered in this publication.

"The 'RP' Series." Bulletin No. 325. 2 pages. The company's complete ink system for rotogravure printing on treated polyethylene film is described in this publication.

Publications of Raybestos-Manhattan, Inc., Manhattan Rubber Division, Passaic, N. J.:

"Poly-V Belt Drives." Data Book No. 10. 112 pages. This engineering data book for the selection and design of the company's Poly-V belt drives contains complete specifications for all drive sizes, a wide range of useful engineering data, and illustrated case histories involving the new drive.

"Conveyor and Elevator Belts." Catalog 25 CB. Specifications of the company's conveyor and elevator belts are contained in this new illustrated catalog.

Publications of E. I. du Pont de Nemours & Co., Inc., elastomer chemicals department, Wilmington, Del.:

"Neoprene Cellular Rubber." R. W. Bedwell. Report No. 57-4. 22 pages. The compounding techniques involved in the production of neoprene sponge products are discussed in this publication. Sample recipes and their test data, which are designed to meet various ASTM, SAE, and AMS specifications for cellular goods, are included. The choice of the proper type of neoprene is particularly stressed.

"Neoprene vs. Neoprene GR-S Blends—a Comparison of Equivalent Cost Compounds." D. C. Thompson and J. F. Hagman. Report BL-320. 4 pages. This report shows comparative data at two different loading and cost levels for compounds of Neoprene Type W and 60/40 blends of Neoprene Type W and SBR 1500. When compared at equal pound volume cost, neoprene compounds have better ozone and oil resistance than compounds based on a blend of neoprene and SBR. The latter, however, because of their higher elastomer content, are superior in some mechanical properties.

"Regrinding Rubber Rolls." Report No. 12. Rodney Hunt Machine Co., Orange, Mass. 2 pages. The need of regrinding rubber rolls, together with information on modern grinding equipment, is discussed in this publication. Specifications and manufacturers of some all-purpose grinding wheels are included.

"Speedline Corrosion-Resistant Fittings." Horace T. Potts Co., Philadelphia, Pa. 21 pages. Specifications and illustrations of the company's fittings for stainless-steel piping installations are contained in this booklet.

"Controlled Volume Barrel Pump." Bulletin 1256. Milton Roy Co., Philadelphia, Pa. 2 pages. The company's barrel pump for accurately metering and pumping toxic or corrosive chemicals directly from barrels or drums to process is described on this data sheet.

"Carbon Graphite Opens New Worlds." Electro-Nite Carbon Co., Philadelphia, Pa. 12 pages. The company's non-lubricated bearings made from carbon-graphite material are described in this illustrated catalog. Properties, load rating charts, standard grade and application data sheets, and operations are included.

Publications of the Office of Technical Services, United States Department of Commerce, Washington, D. C.:

"Research on the Synthesis of Polar Silane Monomers." PB 121498. 30 pages. Price, 75¢. This report of work done by R. M. Silverstein, L. Goodman, and A. Benitez, Stanford Research Institute, for Wright Air Development Center, summarizes the results of a project which had as its objective the synthesis of polymerizable polar silane monomers for use as modifiers for improved silicone rubbers and the copolymerization of certain of the monomers with dimethylsilicone. Of four combinations used, the addition of the Si-H linkage to vinyl and allyl monomers was the most effective for the monomer synthesis.

"The Preparation and Properties of Some New Fluorine-Containing 1,2-Epoxides." PB 121529. 11 pages. Price, 50¢. Six new epoxide monomers, prepared for use as thermally stable elastomers, are described in this report of research done by D. A. Rausch and A. M. Lovelace for Wright Air Development Center. Preparations and properties of the structure of fluorinated epoxides substituted in the 1- and 1,2-positions are discussed. Certain advantages appeared to be offered by the use of the lithium salt of perfluorocarboxylic acid in the preparation of the alkyl perfluoroalkyl ketones.

"Elastomeric Polyphosphates." PB 121516. 49 pages. Price, $1.25. Preparation of an elastomer based on the polyphosphate chain with required thermal, moisture, and lubricant stability is discussed in this report by R. A. Hubbard, II, and U. P. Strauss, Rutgers University, of work done for Wright Air Development Center. Elimination of stiffness in the materials was attempted through use of large cations and plasticizers, and chemical methods were used in an effort to cross-link chains by use of polyvalent cations. Although none of the products prepared showed the required thermal stability, some elastomeric products were obtained, an indication of the soundness of the approach, the report says. The investigators concluded that a thermally stable cation with a built-in plasticizer is required.

"Evaluation of Rot-Resistant Treatments for Elastomer-Coated Fabrics." PB 121420. 51 pages. Price, $1.25. This report by J. B. Ashcroft, Engineer Research & Development Laboratories, U. S. Army, describes a project undertaken to identify a rot-resistant treatment most suitable for rubber-coated cotton textiles. Results showed that interaction between certain fungitoxicants and coatings was detrimental to the base fabric, while it was beneficial between others. Specifications for treatments pend further research.

"Research and Development of Abrasion Resistant Treatments for Nylon Webbings." PB 121494. 79 pages. $2. This is a continuation of the above report. The silicone and catalyst emulsion was found equally effective with nylon parachute webbings.

"AEC Research Reports Price List." No. 27. This free semi-annual price list catalogs 454 Atomic Energy Commission unclassified research reports for sale by OTS. These were acquired since June 30, 1956. More than 3,600 such reports are now available.

"A Review of the Air Force Materials Research and Development Program." H. E. Hines and R. F. Walden. PB 111648-S2. 94 pages. Price, $2.50. Abstracts of 145 reports of research conducted under the Air Force's materials research and development program from July 1, 1955, to June 30, 1956, are contained in this publication. Subjects include adhesives, metallurgy, analysis and measurement, biochemistry, textiles, petroleum products, plastics, packaging, protective treatments, and rubber. The publication is a supplement to three previous volumes of the same title.

Correction

A review of Technical Report RG-102, "Vulcan XC-72," available from Godfrey L. Cabot, Inc., Boston, Mass., and describing the company's extra-conductive furnace black for anti-static and highly conductive rubber and plastic compounds, in our April issue, (page 130), incorrectly stated the designation of the Technical Report as RC-102. The seven-page Technical Report RG-102 also compares the performance of Vulcan XC-72 with other blacks in natural rubber and SBR.

The author of the report, "Vulcan 9 in Butyl Curing Bladders," (same page) is T. D. Bolt, not I. D. Bolt.

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MARKET REVIEWS

Synthetic Rubber

Consumption of all types of synthetic rubber during the first quarter of the year exceeded that for the similar period in 1956 by more than 6% and for the fourth period of 1956 by more than 8.5%. SBR consumption was even more improved. During the first quarter of 1957, consumption of styrene-butadiene was 6% higher than in the similar period of 1956, but was more than 10% higher than consumption in the fourth quarter last year.

The figures show that SBR consumption is increasing in this country at a greater rate than the synthetic rubber industry as a whole.

This unpredicted acceleration undoubtedly has entered the thinking of top management. Clayton F. Ruebensaal, director of commercial planning for Texas-U. S. Chemical Co., points out in a recent magazine article (page 260 of this issue) that on the face of it, synthetic rubber capacity of the United States has been or will be greater than the forecast total domestic rubber hydrocarbon consumption for any year in the 1955-1960 period. However, Mr. Ruebensaal continues, since the beginning of long-range forecasting by the rubber industry, the actual annual consumption in the industry has exceeded by 6-40% the forecast figure that had been made for that year five years earlier. It is exactly this unpredicted acceleration of consumption that the rubber company planners are trying to encompass in their projected expansions and utilize to their own profit.

It is to be noted in this connection that the inventory positions of producers and consumers of SBR at the end of January of this year, the last figure available as of this writing, was less than one month's supply, a figure perhaps just within the margin of safety.

Natural Rubber

The natural rubber price line maintained a relatively steady keel during the March 16-April 15 period as United States consumers continued to maintain their attitude of caution. Only 20,100 tons of rubber were traded on the New York Commodity Exchange during the period, an indifference equally in evidence on the London market. Both Indonesian political troubles and the two-week strike of 16,000 Goodrich workers in the U. S. seemed to have little or no effect on the position of the market.

Speculation on the possible situation in May would have no validity as of this writing, since factors exist that could turn the market in any direction. Observers agree, however, that the market is basically a healthy one.

Statistically, on the New York Commodity Exchange, the 20,100 tons traded during the period were all in the Rex Contract. There were 21 trading days during the period.

Week-end closing Commodity Exchange future prices for the Rex Contract were as follows:

REX CONTRACT

	Feb. 22	Mar. 22	Mar. 29	Apr. 5	Apr. 12
Mar.	30.10	32.70	31.62	—	—
May	30.14	32.85	31.40	31.75	32.10
July	29.85	32.55	31.15	31.60	32.05
Sept.	29.60	32.25	30.90	31.45	31.85
Nov.	29.40	32.05	30.70	31.15	31.55
1958					
Jan.	29.10	31.85	30.50	30.95	31.40
Mar.	28.85	31.65	30.30	30.75	31.25
May	—	—	—	30.55	31.10
Total weekly sales, tons	3,480	5,550	5,910	3,830	4,460

On the physical market, RSS #1 began the period at 32.38¢ a pound, according to the Rubber Trade Association, went to a period-high of 33.13¢ on March 22, and ended the period at 31.88¢ a pound. RSS #1 averaged 32.15¢ during the period and 31.79¢ for the month of March. The grade averaged 32.06¢ for the first half of April. Average March monthly sellers' prices for representative grades were as follows: RSS #3, 31.41¢; #3 Amber Blankets, 28.27¢; and Flat Bark, 21.75¢.

NEW YORK PHYSICAL MARKET
WEEK-END CLOSING PRICES

	Feb. 22	Mar. 22	Mar. 29	Apr. 5	Apr. 12
RSS: #1	30.25	33.13	31.75	31.88	32.25
2	30.00	32.88	31.50	31.63	32.00
3	29.88	32.75	31.25	31.38	31.75
Pale Crepe					
#1 Thick	36.25	37.75	36.75	36.50	36.75
Thin	35.25	36.75	35.75	35.50	35.75
#3 Amber Blankets	27.00	29.25	28.00	28.00	28.13
Thin Brown Crepe	26.25	29.00	27.75	27.75	27.88
Standard Flat Bark	20.25	22.50	21.75	22.00	22.00

Latex

Demand for natural rubber latex during the March 16-April 15 period far exceeded the supply, according to trade sources. Unsold supplies in Malaya and Indonesia for May shipment were said to be almost completely exhausted. In consequence, prices of liquid latex were divorced from the actions of the natural rubber market and were firmer during the period. The scarcity in liquid latex is expected to continue for some months to come.

Reports from the synthetic latex market, sparse as they are, indicated that synthetic latices were continuing to take up some of the slack provided by the shortage of natural latices.

Prices for ASTM Centrifuged Concentrated natural latex, in tank car quantities, f.o.b. rail tank cars, ranged during the period from 39 to 45¢ per pound solids. Prices of synthetic latices were steady at 22 to 32¢ for SBR; 37 to 47¢ for neoprene; and 44 to 54¢ a pound for N types.

Final January and preliminary February domestic statistics for all latices were reported by the United States Department of Commerce as follows:

(All Figures in Long Tons, Dry Weight)

	Production	Imports	Consumption	Month-End Stocks
Type of Latex				
Natural				
Jan.	0	6,460	6,994	11,831
Feb.	0	—	6,756	9,924
SBR				
Jan.	7,228	42	6,288	7,191
Feb.	6,481	—	6,109	7,744
Neoprene				
Jan.	905	0	856	1,329
Feb.	724	0	724	1,052
Nitrile				
Jan.	960	0	841	1,936
Feb.	1,035	0	588	1,583

Reclaimed Rubber

The volume of business in the reclaimed rubber market during the March16-April 15 period showed considerable improvement, according to trade sources, reversing the poor conditions prevailing for the past few months. The traditional spring pickup is now believed to be under way.

Reclaimed rubber prices remained steady over the period.

RECLAIMED RUBBER PRICES

Whole tire: first line	$0.11
Fourth line	.0975
Inner tube: black	.16
Red	.21
Butyl	.14
Pure gum, light colored	.23
Mechanical, light colored	.135

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity at special prices.

Scrap Rubber

There were few new developments in the scrap rubber market during the March 16-April 15 period. Activity on the whole was somewhat greater than during the previous period. Orders for both Naugatuck and Buffalo were regularly filled and shipped.

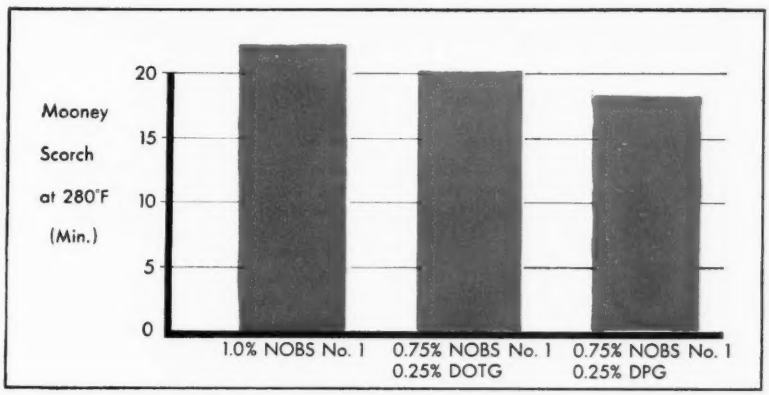
No. 1 peelings dropped $3 a ton dur-

CYANAMID RUBBER Chem Lines

NO. 9 OF A SERIES

Published by AMERICAN CYANAMID COMPANY, Rubber Chemicals Department, Bound Brook, New Jersey

Guanidines as Activators for Delayed-action Accelerators



The effect of DOTG and DPG activation on the processing safety of NOBS No. 1 delayed-action accelerator is shown for SBR furnace black stock.

The largest application for guanidines today is as activators for the thiazoles which have replaced them to a great extent as primary accelerators. The March, 1957 issue of Rubber Chem Lines discussed DPG and DOTG as accelerators and as activators for MBTS. Here we will discuss their effectiveness when used with delayed-action accelerators such as Cyanamid's NOBS* No. 1 and NOBS Special Accelerators.

There are compounding situations where the scorch protection provided by NOBS Accelerators is excessive for a particular set of processing conditions. In such cases guanidines can be used to advantage, permitting a saving in total accelerator cost and a reduction in cure time. Properly used, delayed action accelerators with guanidine activators can produce vulcanizates with optimum physical properties similar to those obtained with thiazoles alone. Naturally, the reduction in scorch protection must be accomplished with sufficient safety for the processing conditions involved.

Take, for example, a typical white rubber stock containing no activating reinforcing fillers, in which NOBS No. 1, if used as an accelerator, is too "slow." Replacing 0.1 part NOBS No. 1 with 0.1 part of DPG lowered the Mooney Scorch at 260°F from 30.5 min. to 27.5 min. Higher modulus and tensile properties were obtained earlier in the curing cycle. The optimum cure time was reduced by 25 to 30 per cent.

Comparison of DPG and DOTG as activators proves DOTG to be safer in regard to scorch protection. A NOBS No. 1 accelerated SBR Furnace Black stock was compared with the same stock activated by .25 part DPG, and activated by .25 part DOTG. Mooney Scorch tests indicate more processing safety with DOTG activation than with DPG. (See graph.) Optimum physical properties were essentially the same in all three stocks.

As might be expected, NOBS Special, due to its greater delayed action as compared with NOBS No. 1, can tolerate a higher proportion of guanidine activation and maintain sufficient scorch protection. In one test, equivalent Mooney Scorch values were obtained with 0.125 part DPG plus 0.875 part NOBS No. 1, and 0.25 part DPG plus 0.75 part NOBS Special.

Detailed information on DPG and DOTG as both primary accelerators and activators is contained in Cyanamid's *Technical Bulletin No. 848.*

Retarder PD in Modern Compounding

The ideal retarder should give good retarding or anti-scorch effects at processing temperatures and very little or no retarding effect during cure. Cyanamid's Retarder PD, a modified phthalic anhydride, has performed effectively for many years with both thiazole and guanidine-thiazole accelerators. Dosages of 0.2 part to 0.5 part Retarder PD based on the rubber hydrocarbon increase processing safety without altering curing characteristics or physical properties. Practically non-discoloring, Retarder PD can be used in white and light-colored stocks.

Typical results with Retarder PD can be illustrated with an MBTS-DPG accelerated natural rubber, white footwear stock. Addition of 0.4 part Retarder PD increased the Mooney Scorch times at 250°F from 6 minutes to 11 minutes (an 83 per cent increase in processing safety). Tensile tests indicated that good physical properties were maintained with the Retarder PD addition.

The increased use of Furnace Blacks in recent years has, however lessened the possible benefits of acidic retarder types such as Retarder PD. The high pH of Furnace Blacks causes a deactivation of the acidic retarders. For application with Furnace Blacks, larger dosages of acidic retarders are necessary to accomplish significant improvements in processing safety. Studies on the economics of retarder use under these conditions have shown that in many cases lower formulating costs and better processing safety can be obtained by using delayed-action accelerators such as NOBS No. 1 or NOBS Special rather than other thiazole or thiazole derivative-retarder combinations.

Your Cyanamid Rubber Chemicals representative is familiar with retarder applications in modern rubber compounds. He can advise you whether to use Retarder PD or our NOBS delayed-action accelerators.

*Trademark

ing the period; while black and red auto tubes rose fractionally. Butyl tubes were off fractionally at eastern points.

Period-end prices of scrap rubber grades were as follows:

	Eastern Points	Akron, O.
	(Per Net Ton)	
Mixed auto tires	$10.00/13.00	$13.50/14.00
S.A.G auto tires	Nom.	Nom.
Truck tires	Nom.	Nom.
Peelings, No. 1	37.00	37.00
2	Nom.	Nom.
3	16.00	17.00
Tire buffing	Nom.	Nom.
	(¢ per Lb.)	
Auto tubes, mixed	2.75	2.75
Black	6.50	6.25
Butyl	3.50	3.75
Red	7.00	7.00

Industrial Fabrics

Overall volume of trading on the industrial fabric market during the March 16-April 15 period was relatively light, according to reports from the trade, but a fair amount of inquiry was received by sellers for various types of wide goods, including drills, sateens, and sheetings. Actual trading of these goods, however, continued restricted, with transactions generally involving very small lots for spot delivery. All transactions were accompanied by price haggling, since it was often difficult to determine the actual market level on most cloth constructions.

Period-end prices of cotton fabrics follow:

INDUSTRIAL FABRICS

Drills		
59-inch 1.85 yd.	yd.	$0.35
2.25-yd.		.30
Ducks		
38-inch 1.78-yd. S.F.	yd.	nom.
2.00-yd. D.F.		.30
51.5-inch, 1.35-yd. S.F.		.4675
Hose and belting		.69
Osnaburgs		
40-inch 2.11-yd.	yd.	.245
3.65-yd.		.16
Raincoat Fabrics		
Printcloth, 38½-in., 64-60, 5.35-yd.	yd.	.135
6.25-yd.		.1175
Sheeting, 48-inch, 4.17-yd.		.20
52-inch, 3.85-yd.		.23
Chafer Fabrics		
14.40-oz./sq. yd. Pl.	yd.	.73
11.65-oz./sq. yd. S.		.61
10.80-oz/sq. yd. S.		.6575
8.9-oz/sq. yd. S.		.67
Other Fabrics		
Headlining, 59-in., 1.65-yd., 2-ply	yd.	.41
64-inch, 1.25-yd., 2-ply		.59
Sateens, 53-inch, 1.32-yd.		.535
58-inch, 1.21-yd.		.585

Rayon

Total packaged production of rayon and acetate filament yarn during March was 63,800,000 pounds, consisting of 33,600,000 pounds of high-tenacity rayon yarn and 30,200,000 pounds of regular-tenacity yarns. February production had been: total, 61,300,000 pounds; regular-tenacity yarn, 32,000,000 pounds; and high-tenacity rayon yarn, 29,300,000 pounds.

Total filament yarn shipments to domestic consumers came to 58,100,000 pounds, of which 25,300,000 pounds were regular-tenacity yarn, and 32,800,000 pounds were high-tenacity rayon yarn. Shipments in February had been: total, 57,300,000 pounds; regular-tenacity yarn, 27,400,000 pounds; and high-tenacity rayon yarn, 29,900,000 pounds.

Total end-of-March stocks were 62,600,000 pounds, made up of 55,000,000 pounds of regular-tenacity yarn and 7,600,000 pounds of high-tenacity rayon yarn. End-of-February stocks had been: total, 59,200,000 pounds; regular-tenacity yarn, 50,600,000 pounds; and high-tenacity rayon yarn, 8,600,000 pounds.

Prices of rayon tire yarns and fabrics in mid-April were unchanged from those of the previous month.

RAYON PRICES

Tire Yarns	
High-Tenacity	
1100/ 480	$0.59/$0.64
1100/ 490	.59/ .64
1150/ 490	.64
1165/ 480	.65
1230/ 490	.64
1650/ 720	.55/ .61
1650/ 980	.55/ .61
1875/ 980	.61
2200/ 960	.55/ .60
2200/ 980	.55/ .60
2200/1466	.64
4400/2934	.60
Super-High-Tenacity	
1650/ 720	.58
1900/ 720	.58
Tire Fabrics	
1100/490/2	.77
1650/980/2	.725
2200/980/2	.715

CALENDAR of COMING EVENTS

May 15-17

Division of Rubber Chemistry, ACS, and Rubber Division, CIC. Joint Meeting. Sheraton-Mt. Royal Hotel, Montreal, P.Q., Canada.

May 20-23

Design Engineering Show; Conference of Machine Design Division, ASME. Coliseum, New York, N. Y.

May 21

Elastomer & Plastics Group, Northeastern Section, ACS. Annual "Short Talk" Symposium.

May 22-24

American Society for Quality Control. Eleventh Annual Convention and Exposition. Masonic Temple, Detroit, Mich.

American Institute of Chemists, Inc. Thirty-Fourth Annual Meeting, Sheraton-Mayflower Hotel, Akron, O.

May 24

Connecticut Rubber Group.

June 1

Southern Ohio Rubber Group.

June 6

New York Rubber Group. Outing. Doerr's Grove, Millburn, N. J.

Rhode Island Rubber Club.

June 7

Fort Wayne Rubber & Plastics Group. Outing. Lake Tippecanoe, Leesburg, Ind.

June 7-8

Southern Rubber Group. Dinkler-Plaza Hotel, Atlanta, Ga.

June 7-9

The Los Angeles Rubber Group, Inc. Summer Outing. Sahara Hotel, Las Vegas, Nev.

June 9-13

American Society of Mechanical Engineers. Semi-Annual Meeting. Sheraton Palace Hotel, San Francisco, Calif.

June 10-August 30

Gordon Research Conferences, Colby Junior College, New London, N. H. (Sessions on Elastomers, July 29-August 2.)

June 11

Buffalo Rubber Group. Outing.

June 13

Northern California Rubber Group.

June 14

Boston Rubber Group. Outing. Andover Country Club, Andover, Mass.

June 16-21

American Society for Testing Materials. Annual Meeting. Atlantic City, N. J.

June 21

Akron Rubber Group. Outing. Firestone Country Club.

June 28

Detroit Rubber & Plastics Group, Inc. Outing.

July 26

Chicago Rubber Group. Golf Tournament. Medinah Country Club, Medinah, Ill.

August 1

New York Rubber Group. Golf Outing. Baltusrol Golf Club, Springfield, N. J.

August 16

Philadelphia Rubber Group. Golf Outing. Manufacturers' Country Club, Oreland, Pa.

September 7

Connecticut Rubber Group.

(Calendar continued on page 312)

Mass building boom takes concrete shape with help of fabric!

Final spraying of concrete on pneumatic form

Inflate a balloon —cover it with wire mesh —spray with concrete—deflate the balloon and another building is complete. Time: 24 hours! That is the procedure currently being used to build low-cost permanent structures—for storage buildings, hangars, schools, homes and other enclosures—in many parts of the world. The huge pneumatic forms, made of rubberized nylon, are fabricated by the Aviation Products Division of Goodyear Tire and Rubber Company, in shapes which permit the erection of half-barrel, spherical, cylindrical, elongated and semi-spherical buildings, along with straight side-walls and rectangular floor plans. Source for the nylon base fabric: Wellington Sears. Though the neoprene hides the nylon, Wellington Sears is proud to play this supporting role, as it does in so many other cases. This is but one of the long list of base fabrics engineered by Wellington Sears for rubber, neoprene or vinyl coatings. More than likely, our century of experience can be useful to you, in solving your problem. If it involves natural or synthetic fabrics in combination with rubber or plastic, call on Wellington Sears. For informative booklet, "Fabrics Plus," write Dept. H-5.

Wellington Sears

FIRST In Fabrics For Industry

For Mechanical Goods, Coated Materials, Tires, Footwear and Other Rubber Products

WEST POINT TEXTILES

WEST POINT MANUFACTURING CO

Wellington Sears Co., 65 Worth St., New York 13, N. Y. • Atlanta • Boston • Chicago • Dallas • Detroit • Los Angeles • Philadelphia • San Francisco • St. Louis

Synthetic Rubbers and Latices*

Monomers

Acrylonitrile	lb.	$0.27	
Butadiene	lb.	.15	
Dow Styrene N99, H99	lb.	.205	
RG	lb.	.17	
Vinyltoluene	lb.	.17	
Hylene M	lb.	3.50	5.00
M-50	lb.	1.90	3.40
T	lb.	1.10	2.65
TM	lb.	.95	2.50
-65	lb.	1.00	2.55
Isobutylene	lb.	.38	
Isoprene	lb.	.25	
Monomer MG-1	lb.	1.00	1.25
Mondur-C	lb.	1.05	
-S	lb.	.85	
Multron R-2	lb.	.54	
Rohm & Haas ethyl acrylate	lb.	.34	.36
Glacial methacrylic acid	lb.	.45	.47
Methyl acrylate	lb.	.37	.39
Methacrylate	lb.	.29	.31

Shortstops

DDM	lb.	.75	.88
Mercaptan 174	lb.	.38	.50
Shortstop 204	lb.	.33	.37
268	lb.	.52	.53
Tecquinol	lb.	.825	.845
Thiostop K	lb.	.53	
N	lb.	.41	
Vulnapol KM	lb.	.52	.53
NM	lb.	.38	.42

Acrylic Types

Hycar 4021	1.35[c]
4501	.81[c]

Fluorocarbon Types

Kel-F Elastomer	lb.	15.00 / 16.00

Isobutylene Types

Enjay Butyl 035, 150, 215, 217, 218, 325	.23[a]
165, 265, 267, 268, 365	.24[a]
Hycar 2202	.65[c]
Polysar Butyl 100, 200, 300, 400	.245[c]
101	.2775[a]
301	.255[c]
Vistanex	.45[a]

Neoprene

Neoprene Type AC, CG	.55[a]
GN, GN-A, WX	.41[a]
GRT, S	.42[a]
KNR	.75[a]
W, WHV	.39[a]
WRT	.45[a]

[a] Freight extra.
[b] Minimum freight allowed.
[c] Freight prepaid.
* Prices are per pound carload or tank-car dry weight unless otherwise specified.
†Listed below are the new SBR type synthetic rubbers and latices trade names and the chief sales offices of their producers or distributors.

Ameripol —Goodrich-Gulf Chemicals, Inc., 3135 Euclid Ave., Cleveland 15, O.
ASRC —American Synthetic Rubber Corp., 500 Fifth Ave., New York 36, N. Y.
Baytown —United Rubber & Chemical Co., Baytown, Tex. (producer); United Carbon Co., Inc., Charleston 27, W. Va. (distributor).
Butaprene, FR-S —Firestone Tire & Rubber Co., Synthetic Rubber Division, 381 Wilbeth Rd., Akron 1, O.
Copo —Copolymer Rubber & Chemical Corp., P. O. Box 2595, Baton Rouge 1, La.
Naugapol, Naugatex —Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.
Philprene —Phillips Chemical Co., Rubber Chemicals Division, 318 Water St., Akron 8, O.
Plioflex —Goodyear Tire & Rubber Co., Chemical Division, Akron 16, O.
Pliolite Latex—Goodyear Tire & Rubber Co., Chemical Division. Also distributed by General Latex & Chemical Corp., 666 Main St., Cambridge 39, Mass.
Polysar —Polymer Corp., Ltd., Sarnia, Ont., Canada (producer); H. Muehlstein & Co., Inc., 60 E. 42nd St., New York 17, N. Y. (distributor).
S- —Shell Chemical Corp., Synthetic Rubber Sales Division 50 W. 50th St., New York 20, N. Y.
Synpol —Texas-U. S. Chemical Co., Port Neches, Tex. (producer); Naugatuck Chemical (distributor).
‡SBR —Styrene butadiene rubber.
§BR —Butadiene rubber.

Latices

Neoprene Latex 571, 842-A	$0.37[a]
572	.39[a]
60, 601-A	.40[a]
635	.41[a]
735, 736	.38[a]
950	.47[a]

Nitrile Types

Butaprene NAA	.54[a]
NF	.49[a]
NL	.50[a]
NXM	.58[a]
Chemigum N1NS	.64[b]
N3NS, N5	.58[b]
N6, N-6B, N7	.50[b]
Hycar 1001, 1041	.58[a]
1002, 1042, 1043, 1312	.50[c]
1014	.60[c]
1411	.62[c]
1432	.59[c]
1441	.64[c]
Paracril AJ	.485[c]
B, BJ, BJLT, BLT	.50[c]
C, CLT	.58[c]
CV	.59[c]
D	.65[c]
18-80	.60[c]
Polysar Krynac 800, 802, 803	.50[c]
801	.58[c]

Latices

Butaprene N-300	.46[b]
N-400, N-401	.54[b]
Chemigum 200	.49[b]
235 CHS, 236	.54[b]
245 B, 245 CHS, 246, 247	.46[b]
Hycar 1512, 1552, 1562, 1577	.46[c]
1551, 1561, 1571	.54[c]
1852	.44[c]
Nitrex 2612, 2614	.46[a]
2615	.51[a]

Polyethylene Type

Hypalon 20	lb.	.85/.88

Polysulfide Types

Thiokol LP-2, -3, -32, -33	.96[a]
-8, -38	1.25[a]
PR-1	.95[a]
Type-A	.47[a]
FA	.69[a]
ST	1.00[a]

Latices

Thiokol Latex (dry wt.)	
Type MF	.85[a]
MX	.70[a]
WD-2	.92[a]
-5	.95[a]
-6, -7	.70[a]

Silicone Types

GE (compounded)	2.25[a]/4.10[a]
Silicone gum (not compounded)	3.85[a]/4.90[a]
Silastic (compounded)	1.95[b]/3.65[b]
(Partly compounded)	3.38[b]/3.90[b]
(Uncompounded)	3.85[b]/4.50[b]
Union Carbide (compounds)	2.35[b]/3.20[b]
(Gums)	3.85[b]/4.25[b]

Styrene Types†

Hot SBR‡

Ameripol 1000, 1001, 1006	.241[c]
1002	.2435[c]
ASRC 1000, 1001, 1004, 1006	.241[c]
1018	.276[c]
1019	.265[c]
FR-S 1000, 1001, 1004, 1006	.241[c]
1009	.2475[c]
1010	.26[c]
1012	.2425[c]
1013	.25[c]
1014	.281[c]
1015	.291[c]
Naugapol 1016, 1019	.265[b]
1018	.27[b]
1021	.30[b]
1022	.28[b]
1023	.285[b]
Philprene 1000, 1001, 1006	.241[b]
1009	.2475[b]
1010	.26[b]
1018	.27[b]
1019	.265[b]
Plioflex 1006	.241[c]
Polysar Kryflex 200, S, S-50	$0.241[c]
SS-250	.30[c]
S-X-371	.255[c]
S-1000, -1001, -1006, -1013	.23[a]
-1002, -1011	.2325[a]
Synpol 1000, 1001, 1006, 1007, 1061	.24[b]
1002	.2435[b]
1012	.2425[b]
1009	.2475[b]
1013	.25[b]

Hot SBR Black Masterbatch

Philprene 1100	.194[b]
1104	.19[b]
S-1100	.185[a]

Cold SBR

Ameripol 1500, 1501, 1502	.241[c]
ASRC 1500, 1502	.241[c]
1503	.2625[c]
1505	.261[c]
1505	.261[c]
Copo 1500, 1502	.241[c]
1505	.261[c]
FR-S 1500, 1502	.241[c]
Naugapol 1503	.2625[b]
1504	.295[b]
Philprene 1500, 1502	.241[b]
1503	.2625[b]
Plioflex 1500, 1502	.241[c]
Polysar Krylene	.241[c]
S-1500, -1501, -1502	.23[b]
Synpol 1500, 1502, 1551	.241[b]

Cold SBR Black Masterbatch

Baytown 1600, 1601, 1602	.176[a]
Philprene 1600, 1601	.193[b]
1605	.19[b]
S-1600, -1601, -1602	.1825[a]

Cold SBR Oil Masterbatch

Ameripol 1703	.206[c]
1705	.2035[c]
1707	.191[c]
1710, 1712	.1885[c]
ASRC 1703	.206[c]
1708	.191[c]
Copo 1712	.1885[c]
FR-S 1703	.206[c]
1705	.2035[c]
1712	.1885[c]
Philprene 1703	.206[b]
1706	.203[b]
1708	.191[b]
1712	.188[b]
Plioflex 1703, 1773	.206[c]
1710, 1712	.1885[c]
1778	.191[c]
Polysar Krynol 651	.1885[c]
652	.191[c]
S-1703	.195[a]
1705, 1706	.1925[a]
-1707	.18[a]
-1709, -1712	.1775[a]
Synpol 1703	.206[b]
1707, 1708	.191[b]
1711	.19[b]

Cold SBR Oil-Black Masterbatch

Baytown 1801	.16[a]
Philprene 1803	.174[b]
S-1801	.1675[a]

Hot SBR Latices

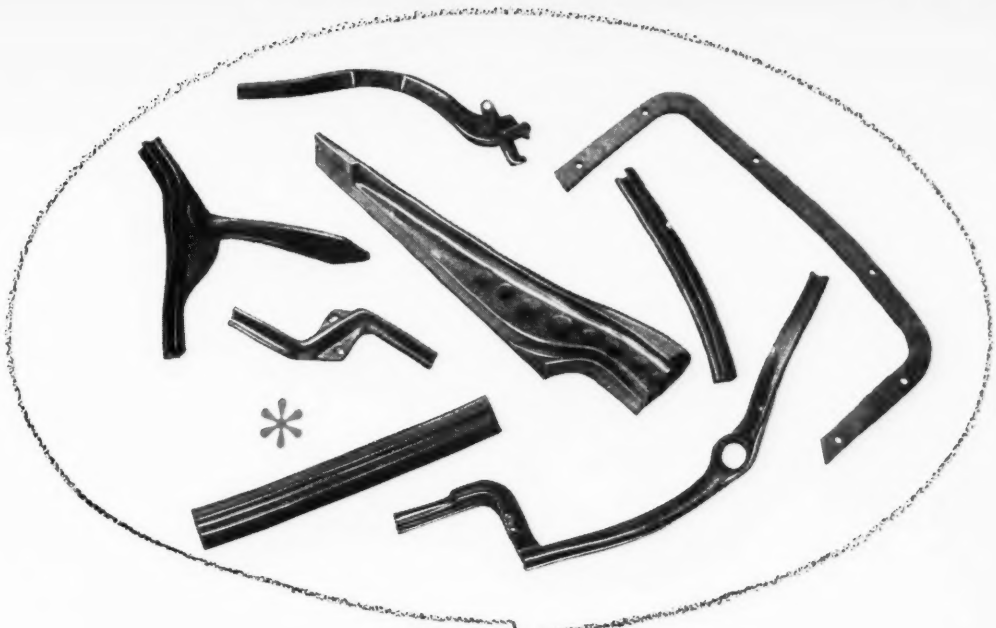
FR-S 2000, 2001, 2006	.26[a]
2002	.285[a]
2003, 2004	.295[a]
Naugatex 2000, 2001, 2006	.263[a]
2002	.288[a]
2005	.30[a]
Pliolite Latex 2000, 2001	.2775[c]
2076	.29[c]
S-2000	.2275[a]
2006	.215[a]

Cold SBR Latices

FR-S 2105	.31[a]
Copo 2101, X-765	.30[c]
2102, 2105	.32[c]
Naugatex 2101	.285[a]
2105	.312[a]
X-767	.323[a]
Pliolite Latex 2101, X765	.30[c]
2104, 2105	.32[c]
S-2101	.225[a]
-2105	.31[a]

Cold BR Latex§

Pliolite Latex 2104	.32[c]



*Everyone's talking about the new "cold," low Mooney polymer

ASRC 3110!

Gives improved processing... better quality!

Rubber parts courtesy of Brown Rubber Co., Inc.

ASRC is now in production with a new, non-staining "cold," low Mooney rubber—ASRC 3110—which offers improved processing of molded and extruded sponge rubber parts. Users can expect easier mixing . . . smoother extrusion . . . faster extrusion rates . . . smoother calendering . . . less shrinkage.

ASRC 3110 also gives improved quality, such as better aging . . . higher tensile strength . . . and better hot tear resistance.

Literature and test samples available upon request.

ASRC

AMERICAN SYNTHETIC RUBBER CORP.

Executive and Sales Offices: 500 5th Ave., New York 36, N. Y.
Midwest Sales Office: 22 Riverbend Pkwy., Fremont, Ohio • Plant and General Offices: Louisville, Ky.
Cable: AMSYNRUB NEWYORK

Compounding Ingredients*

Abrasives

Pumicestone, powdered	lb.	$0.0363	$0.065
Rottenstone, domestic	lb.	.03	.04
Shelblast	ton	80.00	165.00
Walnut Shell Grits	ton	50.00	160.00

Accelerators

A-1 (Thiocarbanilide)	ton	.50	.57
A-32	ton	.66	.80
A-100	lb.	.52	.66
Accelerator 49		.57	.58
52	lb.	1.14	
57, 62, 67, 77	lb.	1.04	
66	lb.	4.25	
89	lb.	1.20	
108	lb.	.91	
552	lb.	2.25	
808	lb.	.66	.68
833	lb.	1.17	1.19
Altax	lb.	.50	.52
Arazate	lb.	2.25	
Beutene	lb.	.66	.71
Bismate	lb.	3.00	
B-J-F	lb.	.27	.32
Butasan	lb.	1.04	
Butazate	lb.	1.04	
Butyl Accelerator Eight	lb.	1.10	1.35
Zimate	lb.	1.04	
Captax	lb.	.40	.42
C-P-B	lb.	1.95	
Cumate	lb.	1.45	
Dibs	lb.	.85	
Diesterex N		.50	.57
Dipac	lb.	.85	
DOTG (diorthotolylguanidine)			
Cyanamid	lb.	.62	.63
Du Pont	lb.	.62	.63
DPG (diphenylguanidine)			
Cyanamid	lb.	.52	.53
Monsanto	lb.	.52	.58
El-Sixty	lb.	.60	.67
Ethasan	lb.	1.04	
Ethazate	lb.	1.04	
50-D	lb.	.85	
Ethyl Thiurad	lb.	1.04	
Tuads	lb.	1.04	
Tuex	lb.	1.04	
Zimate	lb.	1.04	
Ethylac #650	lb.	.93	.95
Guantal	lb.	.60	.67
Hepteen	lb.	.44	.50
Base	lb.	1.85	
Ledate	lb.	1.04	
MBT (2-mercaptobenzothiazole)			
American Cyanamid	lb.	.42	.44
Du Pont	lb.	.42	.44
Naugatuck	lb.	.42	.47
-XXX, Cyanamid	lb.	.53	.55
MBTS (mercaptobenzothiazyl disulfide)			
Cyanamid	lb.	.52	.54
Du Pont	lb.	.52	.54
Naugatuck	lb.	.52	.57
-W Cyanamid	lb.	.57	.59
Merac #225	lb.	.75	1.05
Mertax	lb.	.53	.60
Methasan	lb.	1.04	
Methazate	lb.	1.04	
Methyl Tuads	lb.	1.14	
Zimate	lb.	1.04	
Monex	lb.	1.14	
Mono-Thiurad	lb.	1.14	
2-MT (2-mercaptothiazoline)			
Du Pont	lb.	1.00	
NOBS No. 1	lb.	.74	.76
Special	lb.	.79	.81
O-X-A-F	lb.	.53	.58
Pentex	lb.	1.14	
Flour	lb.	.26	
Permalux	lb.	2.17	
Phenex	lb.	.52	.59
Pip-Pip		2.07	
R-2 Crystals	lb.	4.35	
Rotax	lb.	.51	.53
RZ-50, -50B	lb.	1.00	
S. A. 52	lb.	1.14	
57, 62, 67, 77	lb.	1.04	
66	lb.	2.50	
Santocure	lb.	.74	.81
NS	lb.	.79	.86
Selenacs	lb.	4.25	
SPDX-GH	lb.	.69	.74
GL	lb.	1.20	1.34
Tellurac	lb.	1.21	
Tepidone	lb.	.45	.48
Tetrone A	lb.	1.91	
Thiofide	lb.	.52	.59
S	lb.	.62	.69
Thionex	lb.	1.14	
Thiotax	lb.	.42	.49
Thiurad	lb.	1.14	
Thiuram E	lb.	1.04	
M	lb.	1.14	
Trimene	lb.	.56	.62
Base	lb.	1.03	1.10
Tuex	lb.	1.14	
Ultex	lb.	1.00	1.10
Unads	lb.	1.14	
Ureka Base	lb.	.66	.73
Vulcacure NB	lb.	.45	
NS	lb.	.75	1.05
ZB, ZE, ZM	lb.	.85	.89
Z-B-X	lb.	$2.45	
Zenite	lb.	.52	$0.54
A	lb.	.62	.64
Special	lb.	.53	.55
Zetax	lb.	.51	.53
Zimate	lb.	1.04	

Accelerator-Activators, Inorganic

Lime, hydrated	ton	21.96	
Litharge, comml.	lb.	.175	.18
Eagle, sublimed	lb.	.18	
National Lead, sublimed	lb.	.18	.19
Red lead, comml.	lb.	.185	.195
Eagle	lb.	.19	
National Lead	lb.	.19	.20
White lead, carbonate	lb.	.19	.20
Eagle	lb.	.19	.20
National Lead	lb.	.18	.19
Silicate	lb.	.1725	.1825
Eagle	lb.	.20	.2175
National Lead	lb.	.1625	.1725
Zinc oxide, comml.†	lb.	.145	.1925

Accelerator-Activators, Organic

Aktone	lb.	.2125	.2325
Barak	lb.	.62	
Capital 170	lb.	.215	.255
171	lb.	.1375	.1775
700, 701	lb.	.1575	.1975
705, 710	lb.	.1575	.1975
800	lb.	.1125	.1325
801	lb.	.1475	.1675
802	lb.	.1525	.1725
803	lb.	.175	.195
Curade	lb.	.57	.59
D-B-A	lb.	1.95	
Emery 600	lb.	.1375	.1775
Groco	lb.	.1375	.1775
35	lb.	.1425	.1825
Guantal	lb.	.57	.64
Hyfac 400	lb.	.1063	.1325
430	lb.	.1613	.1875
431	lb.	.1837	.21
Hystrene S-97	lb.	.1863	.2125
T 45	lb.	.1638	.19
T-70	lb.	.1738	.20
Industrene B	lb.	.1263	.1525
R	lb.	.1138	.14
158	lb.	.1313	.1575
254	lb.	.1413	.1675
262	lb.	.1513	.1775
Laurex	lb.	.33	.37
MODX	lb.	.295	.345
NA-22	lb.	1.00	
Oleic acid, comml.	lb.	.185	.225
Emersol 210 Elaine	lb.	.1575	.1975
Groco 2, 4, 8, 18	lb.	.1575	.1975
Plastone	lb.	.27	.30
Polyac	lb.	1.85	
Ridacto	lb.	.25	.26
Seedine	lb.	.1485	.1703
Stearex Beads	lb.	.1488	.1588
Stearic acid			
Emersol 120	lb.	.1463	.1725
150	lb.	.1787	.205
Hydrofoil 51	lb.	.09	
Hydrogenated, rubber grd.			
Groco	lb.	.125	.145
Rufat 75	lb.	.1062	.1325
Single pressed, comml.	lb.	.1475	.1675
Emersol 110	lb.	.1413	.1675
Groco 53	lb.	.1475	.1675
Wilmar 253	lb.	.1413	.1675
Double pressed, comml.	lb.	.1525	.1725
Groco 54	lb.	.1525	.1725
Wilmar 254	lb.	.1463	.1725
Triple pressed, comml.	lb.	.175	.195
Groco 55	lb.	.175	.195
Wilmar 255	lb.	.1688	.195
Sterene 60-R	lb.	.09	.1075
Tonox	lb.	.515	.605
Vulklor	lb.	.88	1.08
Wilmar 110	lb.	.1575	.1975
434	lb.	.1375	.1775
Zinc stearate, comml.	lb.	.39	.44

Antioxidants

AgeRite Alba	lb.	2.35	2.45
Gel	lb.	.64	.66
H. P.	lb.	.72	.74
Hipar	lb.	.98	1.00
Powder	lb.	.52	.54
Resin	lb.	.75	.77
D	lb.	.52	.54
Spar	lb.	.52	.54
Stalite	lb.	.52	.54
S	lb.	.52	.54
White	lb.	1.45	1.55
Akroflex C	lb.	.81	.83
CD	lb.	.76	.78
Albasan	lb.	$0.69	$0.73
Allied AA-1144	lb.	.23	.24
AA-1177	lb.	.155	.165
Aminox	lb.	.55	.60
Antioxidant 425	lb.	2.47	2.50
2246	lb.	1.50	1.53
Antisol	lb.	.23	.24
Antisun	lb.	.15	.51
Antox	lb.	.55	.57
Aranox	lb.	3.25	.54
Betanox Special	lb.	.85	.90
B-L-E, -25	lb.	.55	.60
Burgess Antisun Wax	lb.	.185	
B-X-A	lb.	.55	.60
Copper Inhibiter X-872-L	lb.	2.01	
D-B-P-C	lb.	.91	1.16
Flectol H		.55	.62
Flexamine	lb.	.76	.81
Heliozone	lb.	.31	.32
Ionol	lb.	.91	1.65
Microflake	lb.	.20	.24
NBC	lb.	1.55	
Neozone A	lb.	.59	.61
C	lb.	.83	
D	lb.	.55	.57
Nevastain A	lb.	.51	.61
B	lb.	.51	.70
Octamine	lb.	.55	.60
PDA-10	lb.	.46	.48
Perflectol	lb.	.61	.68
Permalux	lb.	2.17	
Polygard	lb.	.55	.60
Polylite	lb.	.55	.60
Protector	lb.	.26	.31
Rio Resin	lb.	.60	.62
Santoflex 35	lb.	.72	.79
75	lb.	.97	1.04
AW	lb.	.78	.85
B	lb.	.52	.59
BX	lb.	.63	.70
DD	lb.	.55	.62
Santovar A	lb.	1.50	1.57
Santowhite Crystals, Powder	lb.	1.55	1.62
L	lb.	.55	.62
MK	lb.	1.25	1.32
Stabilite	lb.	.55	.59
Alba	lb.	.72	.79
L	lb.	.60	.64
White	lb.	.52	.60
Powder	lb.	.41	.47
Styphen I	lb.	.51	.55
Sunolite #100	lb.	.21	.23
#127	lb.	.17	.19
Sunproof-713	lb.	.25	.30
Improved	lb.	.25	.30
Jr.	lb.	.20	.25
Tenamene 3	lb.	.91	1.05
Thermoflex	lb.	1.00	1.02
Tonox	lb.	.52	.57
Tysonite	lb.	.24	.2475
Velvapex 51-250	lb.	.40	
V-G-B	lb.	.75	.80
Wing-Stay S	lb.	.53	.65
Zenite	lb.	.52	.54

Antiozonants

Tenamene 30, 31	lb.	1.36	1.38
UOP 88, 288	lb.	1.25	1.29

Antiseptics

Copper naphthenate, 6-8%	lb.	.245	
Pentachlorophenol	lb.	.22	.30
Resorcinol, technical	lb.	.775	.785
Zinc naphthenate, 8-10%	lb.	.245	.30

Blowing Agents

Ammonium bicarbonate	lb.	.07	.09
Carbonate	lb.	.16	
Blowing Agent CP 1475	lb.	.32	.35
Celogen	lb.	1.95	
50 C	lb.	1.01	1.07
Sodium bicarbonate	100 lbs.	2.55	3.85
Carbonate, tech.	100 lbs.	1.35	5.52
Sponge Paste	lb.	.20	
Unicel ND	lb.	.76	
NDX	lb.	1.52	
S	lb.	.20	

Bonding Agents

Braze	gal.	6.00	9.00
Cover cement	gal.	2.50	4.00
Chemlok 201	gal.	5.00	6.50
220	gal.	9.75	11.50
602	gal.	25.00	26.00
603	gal.	36.50	37.00
614	gal.	45.00	
Flocking Adhesive RFA17, RFA22, RFA25	lb.	.50	
G-E Silicone Paste SS-15	lb.	4.52	5.10
SS-64	lb.	3.65	6.75
-67 Primer	lb.	7.50	12.50
Gen-Tac Latex	lb.	.70	.805
Hylene M	gal.	3.50	3.75
M-50	gal.	1.90	2.15
Kalabond Adhesive	gal.	6.50	16.00
Tie Cement	gal.	2.00	5.60
Thixons	gal.	1.48	12.00
Ty Ply, BN, Q. S. UP, 3640	gal.	6.75	8.00
RC	gal.	3.75	5.00

Brake Lining Saturants

BRT 3	lb.	.018	.0265
Resinex L-S	lb.	.0225	.03

* Prices, in general, are f.o.b. works. Range indicates grade or quantity variations. No guarantee of these prices is made. Spot prices should be obtained from individual suppliers.

† For trade names, see Color—White, Zinc Oxides.

‡ At the request of the suppliers, the lowest prices shown for carbon blacks are for carloads in bags. Prices for hopper carloads are lower.

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Carbon Blacks‡

Conductive Channel—CC

Continental R-40	lb.	$0.23	$0.30
Kosmos Dixie BB	lb.	.23	.30
Spheron C	lb.	.15	.195
Voltex	lb.	.18	.315

Easy Processing Channel—EPC

Collocarb EPC	lb.	.059	.099
Continental AA	lb.	.074	.1225
Kosmobile 77 Dixiedensed 77	lb.	.074	.1225
Micronex W-6	lb.	.0775	.145
Spheron #9	lb.	.0725	.1225
Texas E	lb.	.074	.1225
Witco #12	lb.	.074	.1225
Wyex EPC	lb.	.0775	.135

Hard Processing Channel—HPC

Continental F	lb.	.074	.1225
HX HPC	lb.	.074	.1225
Kosmobile S Dixiedensed S	lb.	.074	.1225
Micronex Mk. II	lb.	.0775	.145
Witco #6	lb.	.074	.1225

Medium Processing Channel—MPC

Arrow MPC	lb.	.0775	.135
Continental A	lb.	.074	.1225
Kosmobile S-66 Dixiedensed S-66	lb.	.0775	.145
Micronex Standard	lb.	.0725	.14
Spheron #6	lb.	.0725	.1225
Texas 109	lb.	.079	.1275
Witco #1 M	lb.	.074	.1225
	lb.	.074	.1225

Conductive Furnace—CF

Aromex CF	lb.	.0875	.145
Vulcan C	lb.	.105	.15
SC	lb.	.18	.223

Fast Extruding Furnace—FEF

Arovel FEF	lb.	.0675	.125
Continex FEF	lb.	.06	.10
Kosmos 50 Dixie 50	lb.	.06	.10
Statex M	lb.	.0675	.125
Sterling SO	lb.	.0625	.10

Fine Furnace—FF

Statex B	lb.	.0725	.13
Sterling 99	lb.	.0675	.105

High Abrasion Furnace—HAF

Aromex HAF	lb.	.0775	.135
Continex HAF	lb.	.079	.125
Kosmos 60 Dixie 60	lb.	.079	.1175
Philblack O	lb.	.0775	.125
Statex R	lb.	.0775	.135
Vulcan #3	lb.	.0725	.114

Intermediate Super Abrasion Furnace—ISAF

Aromex ISAF	lb.	.0925	.15
Kosmos 70 Dixie 70	lb.	.10	.145
Philblack I	lb.	.0925	.14
Statex 125	lb.	.0925	.15
Vulcan 6	lb.	.0875	.13

Medium Abrasion Furnace—MAF

Philblack A	lb.	.0675	.115

Super Abrasion Furnace—SAF

Philblack E	lb.	.115	.1625
Vulcan 9	lb.	.115	.165

General Purpose Furnace—GPF

Arogen GPF	lb.	.06	.1175
Sterling V	lb.	.055	.09
V Non-staining	lb.	.05	.09

High Modulus Furnace—HMF

Collocarb HMF	lb.	.045	.085
Continex HMF	lb.	.055	.095
Kosmos 40 Dixie 40	lb.	.055	.095
Modulex HMF	lb.	.0625	.12
Statex 93	lb.	.0625	.12
930	lb.	.047	.087
Sterling L, LL	lb.	.0575	.095

Semi-Reinforcing Furnace—SRF

Collocarb SRF	lb.	.042	.082
Continex SRF	lb.	.045	.085
Essex SRF	lb.	.0575	.115
Furnex	lb.	.0575	.115
Gastex	lb.	.0575	.0925
Kosmos 20 Dixie 20	lb.	.045	.085
Pelletex, NS	lb.	.0525	.0875
Sterling NS, S	lb.	.0475	.0875
R	lb.	.0575	.0925

Fine Thermal—FT

P-33	lb.	.0575	
Sterling FT	lb.	.0575	

Medium Thermal—MT

Sterling MT	lb.	.04	
Non-staining	lb.	.05	
Thermax	lb.	$0.04	
Stainless	lb.	.05	

Colors

Black

Iron oxides, commil.	lb.	.1235	.135
BK—Lansco	lb.	.1275	.13
Williams	lb.	.145	
Lansco synthetic	lb.	.10	
Mapico	lb.	.1475	.15
Lampblack, commil.	lb.	.16	.45
Superjet	lb.	.085	.12
Permanent Blue	lb.	.80	1.05
Stan-Tone	lb.	.45	1.20
Vansul masterbatch	lb.	.60	.65
Paste	lb.	.14	.15

Blue

Alkali Blue	lb.	1.12	2.10
Cyanamid ultramarine	lb.	.29	
Du Pont	lb.	1.77	4.55
Filo	lb.	.28	
Heveatex pastes	lb.	.80	1.45
Lansco ultramarines	lb.	.25	.28
Monsanto Blue 7	lb.	1.55	
11	lb.	3.45	
DPB-283	lb.	1.93	
S-11	lb.	2.05	
Permanent Blue	lb.	.80	1.05
Stan-Tone	lb.	1.55	1.60
Vansul masterbatch	lb.	.90	2.70

Brown

Filo	lb.	.13	
Iron oxides, commil.	lb.	.1425	.145
Lansco synthetic	lb.	.125	
Mapico Brown	lb.	.1575	.16
Sienna, burnt, commil.	lb.	.0425	.155
Williams	lb.	.115	.1775
Raw, commil.	lb.	.045	.1325
Williams	lb.	.08	.1725
Umber, burnt, commil.	lb.	.06	.07
Williams	lb.	.0725	.085
Raw, commil.	lb.	.0625	.07
Williams	lb.	.07	.0825
Williams, pure brown	lb.	.155	
Vandyke	lb.	.12	
Mapico Tan	lb.	.2325	.235
Metallic Brown	lb.	.05	.06
Vansul masterbatch	lb.	2.10	2.20

Green

Chrome	lb.	.19	.50
Green	lb.	.80	2.40
Oxide	lb.	.3925	1.10
Cyanamid	lb.	1.10	
G-4099, -6099	lb.	.4525	
GH-9869	lb.	1.10	1.25
9976	lb.	1.20	1.35
Du Pont	lb.	1.97	2.80
Filo	lb.	.40	
Heveatex pastes	lb.	.95	1.85
Lansco Toner	lb.	1.35	
Monsanto Green 3	lb.	2.75	
14	lb.	1.45	
17	lb.	3.95	
71205	lb.	1.35	
DGP	lb.	2.03	
S-17	lb.	2.25	
Stan-Tone	lb.	1.75	4.60
Vansul masterbatch	lb.	2.00	2.60

Orange

Cyanamid Permatons	lb.	1.35	
Du Pont	lb.	2.75	
Monsanto Orange 68187	lb.	2.90	
Stan-Tone	lb.	.70	5.05
Vansul masterbatch	lb.	2.00	2.60

Red

Antimony trisulfide	lb.	.285	.315
R. M. P. No. 3	lb.	.72	
Sulfur Free	lb.	.78	
Brilliant Toning Red	lb.	1.95	
Cadmium red lithopones	lb.	2.21	3.77
Cadmolith	lb.	1.72	2.20
Cyanamid	lb.	.80	1.60
Du Pont	lb.	1.47	1.90
Filo	lb.	.11	
Indian Red	lb.	.1275	
Iron oxide, commil.	lb.	.06	.13
Lansco synthetic	lb.	.1175	
Mapico	lb.	.1425	.145
Recco	lb.	.12	
Williams Red	lb.	.13	.1525
Monsanto Maroon 113	lb.	1.50	
61148	lb.	1.75	
Red 7	lb.	1.55	
41	lb.	4.40	
3501	lb.	1.15	
4004	lb.	1.50	
69191	lb.	3.38	
Autumn	lb.	1.10	
PRP-285	lb.	1.27	
S-44	lb.	1.28	
Rub-Er-Red	lb.	.0975	
Stan-Tone	lb.	.85	6.15
Vansul masterbatch	lb.	.95	3.30
Venetian	lb.	.04	.0675

White

Antimony oxide	lb.	.27	.285
Burgess Iceberg	ton	50.00	80.00
Cryptone BT	lb.	.10	.11
Permolith lithopone	lb.	$0.08	$0.0875
Titanium pigments			
Horse Head Anatase	lb.	.255	.27
Rutile	lb.	.275	.29
Rayox LW	lb.	.195	.205
R-110	lb.	.215	.225
Ti-Cal	lb.	.075	.0825
Ti-Pure	lb.	.195	.225
Titanox A, AA, A-168	lb.	.21	.22
C-50	lb.	.1225	.1275
RA, -10, -50	lb.	.23	.24
RC	lb.	.0825	.0875
-HT, -HTX	lb.	.08	.085
Unitane	lb.	.255	.285
Zopaque Anatase	lb.	.245	.27
Rutile	lb.	.205	.29
Zinc oxide, commil.	lb.	.145	.1825
Azo ZZZ-11, -44, -55	lb.	.145	.165
20% leaded	lb.	.1505	.1705
35% leaded	lb.	.155	.175
50% leaded	lb.	.1588	.1788
Eagle AAA, lead free	lb.	.145	.155
5% leaded	lb.	.145	.155
35% leaded	lb.	.155	.165
50% leaded	lb.	.159	.169
Florence Green Seal	lb.	.1625	.1725
Red Seal	lb.	.1575	.1675
White Seal	lb.	.1675	.1775
Horsehead XX-4, -78	lb.	.145	.155
Kadox-15, -17, -72, -515	lb.	.145	.155
-25	lb.	.1675	.1775
Lehigh, 35% leaded	lb.	.155	.175
50% leaded	lb.	.1588	.1788
Protox-166, -167	lb.	.145	.165
St. Joe, lead free	lb.	.122	.152
Zinc sulfide, commil.	lb.	.253	.263
Cryptone ZS	lb.	.253	.273

Yellow

Cadmium yellow lithopones	lb.	1.12	1.15
Cadmolith	lb.	1.12	1.20
Cyanamid Hansa Yellow	lb.	2.10	
Du Pont	lb.	1.80	2.25
Filo	lb.	.10	
Iron oxide, commil.	lb.	.0525	.1175
Lansco synthetic	lb.	.1075	
Mapico	lb.	.12	.1275
Williams	lb.	.115	.1225
Monsanto Yellow 14	lb.	1.91	
10010	lb.	1.91	
BYP-282	lb.	1.21	
GA	lb.	2.45	
S-10010	lb.	1.17	
Stan-Tone	lb.	1.00	1.55
Vansul masterbatch	lb.	.95	1.95
Williams Ocher	lb.	.0575	.06

Dusting Agents

Diatomaceous silica	ton	32.00	48.00
Extrud-o-Lube, conc	gal.	1.33	1.69
Glycerized Liquid Lubricant, concentrated	gal.	1.25	1.63
Latex-Lube GR	lb.	.20	
Pigmented	lb.	.1825	
R-66	lb.	.165	
Liqui-Lube	lb.	.1625	
N. T.	lb.	.1675	
Liquizinc No. 305	lb.	.30	.35
Lubrex	lb.	.25	.30
Mica Concord	lb.	.075	.0825
Mineralite	ton	45.00	
Pyrax A	ton	13.50	
W. A.	ton	16.00	
Talc, commil.	ton	18.40	38.50
EM	ton	11.00	63.00
LS Silver	ton	29.25	
Nytals	ton	25.00	36.00
Sierra Sagger 7	ton	34.00	
White IR	ton	19.75	
III	ton	20.75	
Vanfre	gal.	2.00	

Extenders

BRS 700	lb.	.02	.0285
BRT 7	lb.	.03	.031
Cumar Resins	lb.	.065	.17
Dielex B	lb.	.06	
Factice, Amberex	lb.	.29	.36
Brown	lb.	.1425	.263
Neophax	lb.	.157	.268
White	lb.	.144	.285
G. B. Asphaltenes	lb.	.06	.065
Millex, W	lb.	.07	
Mineral Rubbers			
Black Diamond	ton	38.00	40.00
Hard Hydrocarbon	ton	46.50	48.50
Hydrocarbon MR	ton	45.00	55.00
Parmr	ton	21.00	29.00
T-MR Granulated	ton	47.50	50.00
Nuba No. 1, 2	lb.	.0575	.0625
3X	lb.	.0775	.0825
OPD-101	lb.	.26	
Rubber substitute, brown	lb.	.16	.2572
Car-Bel-Ex A	lb.	.14	
Car-Bel-Lite	lb.	.35	
Extender 600	lb.	.1765	
White	lb.	.192	.2103
Stan-Shells	ton	35.00	73.00
Sublac Resin PX-5	lb.	.215	.235
Sundex 53	gal.	.12	
85	gal.	.1725	
Synthetic 100	lb.	.41	
Vistanex	lb.	.35	.475

Fillers, Inert

Agrashell flour	ton	50.00	74.00
Albacar	ton	55.00	75.00

CLASSIFIED ADVERTISEMENTS

ALL CLASSIFIED ADVERTISING MUST BE PAID IN ADVANCE

GENERAL RATES

Light face type $1.25 per line (ten words)
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Light face type $1.00 per line (ten words)
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Letter replies forwarded without charge, but no packages or samples.

Address All Replies to New York Office at 386 Fourth Avenue, New York 16, N. Y.

SITUATIONS WANTED

GENERAL OR PLANT MANAGER: 20 YEARS' WELL-ROUNDED and diversified background in all phases of Rubber Goods Processing, Technical and Manufacturing. Splendid record in management, labor relations, cost reductions, inventory and production controls. Knows all types of machinery, processing techniques, etc. Very aggressive. Prefers Southwest or West Coast location. Address Box No. 2058, care of RUBBER WORLD.

TECHNICAL SUPERINTENDENT EMPLOYED BY MEDIUM-size wire manufacturer seeks challenging executive position. Experienced in Vinyl, Polyamide, Polyethylene, and rubber extrusions for wire coatings. Familiar with wire specifications, 20 years' experience in Vinyl and Rubber compounding, Dry Blending, Laboratory evaluations, development work. Willing to relocate. No objection to limited traveling. Address Box No. 2059, care of RUBBER WORLD.

RUBBER CHEMIST, B.S., DEVELOPMENT AND PRODUCTION compounding. Six years' experience all phases of heels and soling and some mechanicals. Address Box No. 2060, care of RUBBER WORLD.

PLANT MANAGER—PARTNER: Graduate Chemical Engineer aged 37, having more than 10 years' experience in developing products and compounds for the mechanical rubber industry, having at the same time top management responsibilities regarding labor and production, desires to locate with a progressive rubber company which will permit applicant to purchase substantial portion of firm. Address Box No. 2063, care of RUBBER WORLD.

SITUATIONS OPEN

IN SUNNY SOUTH CAROLINA

1. Rubber and Plastics Chemists and Compounders. 2. Mill and Calender room Foreman and Supervisor. 3. Rubber mill Maintenance and Development Engineers. New opportunities for growth in the new South. Write or call today. CONTINENTAL TAPES, CAYCE, S. C.

LATEX CHEMIST—WELL ESTABLISHED AND GROWING MANUfacturer of rubber chemicals and producer of rubber latex compounds has an opening for a good latex chemist to work in group of four chemists working closely with Sales Dept. on potential product outlets. Good facilities in a creative atmosphere. B.S. Chem. minimum education with up to 5 yrs.' experience. Vacation and benefits. Salary open. Send résumé and small, non-returnable snapshot to: Mr. C. E. Cain, ALCO OIL & CHEMICAL CORPORATION, Trenton Avenue & William Street, Philadelphia 34, Penna.

RUBBER CHEMIST—POSITION OPEN

We have an opening in our Seal Division for a man thoroughly familiar with the precision molding of small rubber parts. It is desired that any applicant have had wide experience in rubber compounding, particularly oil-resistant types and for application under other varying fluid and temperature conditions. We prefer that the applicant be college trained, possibly with a degree in chemistry. This position offers a significant future potential and will involve the responsibility for development of rubber compounds and setting up and supervising a rubber laboratory. This is an excellent position with an attractive salary. Our employes know of this ad. Address Box No. 2061, care of RUBBER WORLD.

ADHESIVE CHEMISTS & ENGINEERS

For Product Development
Salaries to $9,000

Newly formed division of an established major manufacturer located in Northeast is seeking qualified men with minimum 3 years experience in bench work on SOLVENT TYPE RUBBER & RUBBER-RESIN ADHESIVES AND SEALERS for industrial uses.
. . . Liberal company benefits . . . Moving allowances . . . Payment of agency fees
A unique group which is offering interesting work, excellent advancement opportunities & growth potential

Resumes will be kept in strictest confidence
Write to G. C. Dean or V. A. Hollnberger

ENGINEERING EMPLOYMENT SERVICE INC.
217 Broadway, N. Y. 7, N. Y. Established 1925

SITUATIONS OPEN (Continued)

CHEMIST NEEDED

This is a very interesting job occasionally requiring round-the-world trips to our over sixty affiliated companies. Needless to say, this job pays better than average for a better-than-average man and it takes a better-than-average man to fill the job. The man who had this job has now been promoted to General Manager of one of our subsidiaries.

WELLCO-RO-SEARCH
Waynesville, North Carolina

RESIN CHEMIST

A world-known, research-minded organization has a challenging opportunity for a young European educated resin chemist or technologist with a background in polymer research and production engineering of raw material. Prefer approximately ten years' experience. Knowledge of English required.
First duties will be to apply acquired knowledge to thermosetting resin utilization in an industrial product. Eventually could be asked to emigrate with family for permanent residence to headquarters of Company located in Eastern United States. Please write in English, sending all details and snapshot photo. All replies will be held in strict confidence and addressed to Dr. W. F. L. Place, Boite Postale 8, Conflans (Seine et Oise) France.

PLANT MANAGER WITH PRACTICAL COMPOUNDING EXPERIence for Eastern molding plant employing 100. Address Box No. 2064, care of RUBBER WORLD.

PRODUCTION MANAGER

experienced in rubber and vinyl flooring and soling. Excellent opportunity with well-established concern located in the East. All replies will be held strictly confidential.

ADDRESS BOX NO. 2065, c/o RUBBER WORLD

MACHINERY & SUPPLIES FOR SALE

COMPLETE CONTINUOUS RAYON/NYLON FABRIC TREATER
60 YPM CAPACITY AT 10,000# TENSION

Five drum predry with festoon dry end complete with direct gas-fired convection heaters, controls etc. Complete Reliance V/S drive. Can be used in full calender train operation. Can be inspected in operation. Unit available August or September. For outline specifications write:

Box No. 2052, c/o RUBBER WORLD.

Barytes, floated, white	ton	$49.00	$70.85
Off-color, domestic	ton	25.00	
No. 1	ton	49.00	71.50
2	ton	47.00	69.50
Sparmite	ton	90.00	110.00
Blanc fixe	ton	100.00	165.00
Burgess Iceberg	ton	50.00	80.00
Pigment #20	ton	35.00	60.00
#30	ton	37.00	60.00
HC-75	ton	12.00	30.00
-80	ton	14.00	32.00
WP #1	ton	11.00	16.00
Cary #200	ton	30.00	55.00
Citrus seed meal	lb.	.04	
Oil	lb.	.15	
Clays			
A. F. D. Filler	ton	26.50	100.00
Aiken	ton	14.00	
Albacar	ton	50.00	55.00
Aluminum Flake	ton	22.25	60.00
#5	ton	24.50	30.00
Champion	ton	14.00	
Crown	ton	14.00	33.00
Dixie	ton	14.00	
Franklin	ton	13.50	35.25
GK Soft Clay	ton	11.00	
Harwick	ton	15.50	55.50
Hi-White R	ton	13.50	
Hydratex R	ton	28.00	
Kaolloid	ton	10.50	
Paragon	ton	13.50	31.50
McNamee	ton	13.50	
RX-43	ton	33.00	
Recco	ton	14.00	
Sno-Brite	ton	12.50	
Stan-Clay	ton	28.00	
Stellar-R	ton	50.00	
Suprex	ton	14.00	32.00
Swanee	ton	12.50	
Windsor	ton	14.00	30.00
DC Silica	lb.	1.45	1.65
Diatomaceous silica	ton	32.00	48.00
Flocks			
Cotton, dark	lb.	.095	.135
Dyed	lb.	.55	.60
White	lb.	.13	.33
Fabrifil X-24-G	lb.	.135	
X-24-W	lb.	.235	
Filfloc 6000	lb.	.33	
F-40-900	lb.	.135	
HSC #35 Silicone Emulsion	lb.	1.22	2.46
Kalite	ton	50.00	65.00
Lithopone, comml.	lb.	.075	.085
Astrolith	lb.	.068	.0675
Eagle	lb.	.0725	.075
Permolith	lb.	.08	.0875
Sunolith	lb.	.075	.0825
Mica Concord	lb.	.075	.0825
Millical	ton	38.00	53.00
Mineralite	ton	40.00	60.00
Non-Fer-Al	ton	32.50	47.50
Purecal	ton	56.75	71.75
Pyrax A	ton	13.50	
W. A.	ton	16.00	
Sawdust	ton	14.00	35.00
Silversheen Mica	lb.	.08	.09
StanWhite	ton	10.50	13.10
Super-White Silica	ton	25.00	46.50
Surfex	ton	37.50	52.50
MM	ton	39.50	54.50
Suspenso	ton	35.50	50.50
Ti-Cal	lb.	.0675	
Valron Estersil	lb.	2.00	2.25
Walnut shell flours	ton	50.00	84.00
Whiting, limestone			
Atomite	ton	30.00	
Calcite	ton	23.00	
Calwhite	ton	20.00	
-T	ton	23.00	
Gamaco	ton	32.50	
Keystone	ton	16.00	
Laminar	ton	30.00	
No. 10 White	ton	11.00	
Omya	ton	30.00	
Paxinosa	ton	11.00	19.00
Snowflake	ton	17.00	18.00
Stonelite	ton	9.00	
Witco	ton	8.50	
York	ton	9.50	

Finishes

Apex Bright Finish #5200-E	lb.	.25	
Rubber Finish	gal.	2.50	
Black-out	gal.	4.50	8.00
Flocks, Rayon, colored	lb.	.90	1.50
White	lb.	.75	1.25
Also see Flocks, under Fillers, Inert			
Rubber lacquer, clear	gal.	1.00	2.00
Shellacs, Angelo	lb.	.485	.7325
Vac Dry	lb.	.485	.57
Talc *(See Talc, under Dusting Agents)*			
Unidip	lb.	.15	.20
Wax, Bees	lb.	.68	.83
Carnauba	lb.	.57	1.13
Monten	lb.	.27	
No. 118, colors	gal.	.86	1.41
Neutral	gal.	.76	1.31
Van Wax	gal.	1.45	1.50

Latex Compounding Ingredients

Acintol D, DLR	lb.	.06	.075
FA #1	lb.	.065	.08
#2	lb.	.075	.09
Accelerator 552	lb.	$2.25	
J-117, -302	lb.	1.00	$1.15
-144	lb.	.15	.30
-307	lb.	1.10	1.25
-311	lb.	.60	.75
Aerosol, dry types	lb.	.39	1.20
Liquid types	lb.	.40	.72
Alcogum AA-16, MA-16	lb.	.20	.24
AK-12, PA-10	lb.	.12	.14
AN-6	lb.	.05	.075
-10	lb.	.085	.10
Alrosol	lb.	.41	
Amberex solutions	lb.	.1675	.18
Antifoam J-114	lb.	3.25	3.45
P-242	lb.	.24	.35
Antioxidant J-137, -140	lb.	.55	.70
-139, -293	lb.	1.45	1.60
-182	lb.	2.00	2.15
-186	lb.	1.40	1.55
2246	lb.	1.50	1.53
Anti Webbing Agent J-183	lb.	.75	.90
-297	lb.	.27	.40
Aquablak B	lb.	.0975	.1025
G	lb.	.12	.125
K	lb.	.12	.125
M	lb.	.105	.11
Aquarex D	lb.	.78	
G	lb.	.21	
L	lb.	.94	
MDL	lb.	.33	
ME	lb.	.80	
Aquarex NS	lb.	.60	
SMO	lb.	.50	
WAQ	lb.	.22	
Areskap 50	lb.	.30	.38
100, dry	lb.	.60	.72
Aresket 240	lb.	.30	.38
300, dry	lb.	.60	.72
Aresklene 375	lb.	.42	.57
Ben-A-Gels	lb.	.98	1.40
Bentone 18, 18C	lb.	.45	
34	lb.	.60	
Casein	lb.	.22	
Cellosize WP-09, -3, -40			
-300	lb.	1.00	1.17
CW-12		.85	
-37	lb.	.70	
DC Antifoam A Compound	lb.	5.45	6.65
Emulsion	lb.	2.05	4.00
AF Emulsion	lb.	2.05	2.85
Compound 7	lb.	5.13	6.50
Defoama W-1701	lb.	.125	
Defoamer 115a	lb.	.50	
Dispersing Agents			
Blancol	lb.	.1525	.26
N	lb.	.155	.26
Darvan Nos. 1, 2, 3	lb.	.22	.30
Daxad 11, 21, 23, 27	lb.	.08	.30
Dispersaid H7A	lb.	.58	
1159	lb.	.43	
Emulphor ON-870	lb.	.50	.70
Igepal CO-630	lb.	.2875	.47
Igepon T-73	lb.	.285	.495
T-77	lb.	.45	.69
Indulins	lb.	.06	.08
Kreelons	lb.	.132	.155
Laurelton Oil	lb.	.18	
Leonil SA	lb.	.52	.65
Lomar PW	lb.	.18	
Marasperse CB	lb.	.1225	.1425
N	lb.	.095	.105
Modicols	lb.	.17	.58
Nekal BA-75	lb.	.395	.54
BX-76	lb.	.63	.75
Orzan A	lb.	.0325	
S	lb.	.0425	
Pluronics	lb.	.335	.40
Polyfons	lb.	.08	.09
Sorapon SF-78	lb.	.28	.40
Tergitol NPX	lb.	.275	.3074
TMN	lb.	.2875	.32
7	lb.	.4125	.44
Trenamine W-30	lb.	.15	
W-40	lb.	.60	.75
Triton R-100	lb.	.12	.25
X-100, -102, -114	lb.	.255	.36
Dispersions			
Agebest 1293-22	lb.	1.90	2.00
AgeRite Alba	lb.	3.00	
Powder, Resin D	lb.	.80	
White	lb.	1.80	
Altax	lb.	.75	
Shield Nos. 2, 6	lb.	.08	
3	lb.	.095	
4-35	lb.	.09	
5	lb.	.093	
7-F, 8	lb.	.165	
55	lb.	.18	
Iron Oxide, 60%	lb.	.40	
L.S.W.	lb.	1.50	
No. 305 Liquizinc	lb.	.30	.35
P-33	lb.	.35	
Rotax	lb.	.75	
Sulfur	lb.	.12	.30
No. 2	lb.	.14	.16
Telloy	lb.	3.00	
Tuads, Methyl	lb.	1.60	
Vulcacure NB	lb.	.45	
NS	lb.	.75	1.05
ZB, ZE, ZM	lb.	.85	.89
Vulcanizing, C group	lb.	.40	1.30
G group	lb.	.45	.90
N group	lb.	.40	1.00
Vulcafoams	lb.	.40	.70
Vulcanols	lb.	.75	.80
Zetax	lb.	.75	
Zimates, Butyl	lb.	1.30	
Ethyl, Methyl	lb.	1.35	
Zinc oxide	lb.	.40	
Emulsions			
AgeRite Stalite	lb.	$0.75	
Borden Arcco A-25,			
A-26, 716-30	lb.	.18	$0.19
555-40-R	lb.	.185	.205
620-32B	lb.	.20	.21
716-35	lb.	.17	.18
1041-21	lb.	.165	.175
Habuco Resin Nos. 502,			
515, 523	lb.	.195	.20
503	lb.	.22	.225
504, 526	lb.	.19	.195
517	lb.	.175	.18
524	lb.	.155	.16
Resin A-2	lb.	.16	.25
P-370	lb.	.175	.25
X-210	lb.	.12	.22
Freeze-Stabilizer 322	lb.	.40	
12116C	lb.	.52	
Igepon T-43	lb.	.145	.35
T-51	lb.	.125	.285
-73	lb.	.285	.495
Ludox	lb.	.1675	.195
Marmix	lb.	.41	.48
Merac	lb.	.75	1.05
Micronex, colloidal	lb.	.06	.072
Monsanto Blue 4685 WD	lb.	1.60	
Green 4884 WD	lb.	1.80	
Red 127	lb.	1.25	
OPD 101	lb.	.16	.26
Picco Latex Plasticizer A-12	lb.	.069	.096
Pliolite Latex 150, 190	lb.	.32	.41
170	lb.	.37	.46
Polyvinyl methyl ether	lb.	.25	.45
Resin V	lb.	.13	
Roelgel 100C	lb.	.46	
Santomerse D	lb.	.44	.65
S	lb.	.13	.25
Sellogen Gel	lb.	.1275	
Sequestrene AA	lb.	.905	.975
30A	lb.	.245	.265
ST	lb.	.585	.615
Setsit #5	lb.	.75	1.05
Stablex A	lb.	.80	1.10
B, G	lb.	.50	.95
K	lb.	.27	.35
Stablex P	lb.	.35	.50
T	lb.	.14	.22
Surfactol 13	lb.	.345	.36
Webnix	lb.	1.50	2.50

Mold Lubricants

Acintol D	lb.	.06	.075
A-C Polyethylene	lb.	.30	.37
Alipal CO-433	lb.	.25	.45
CO-436	lb.	.22	.41
Aquarex Compounds	lb.	.21	.94
Carbowax 200, 300, 400	lb.	.22	.25
1500	lb.	.255	.2825
4000	lb.	.31	.32
6000	lb.	.35	.36
Castorwax	lb.	.3375	.3575
Colite Concentrate	gal.	.90	1.15
D-Tak Dip #10	gal.	1.50	
DC Mold Release Fluid	lb.	3.14	4.75
Compound 4, 7	lb.	5.13	6.50
Emulsion 7	lb.	1.59	2.07
8, 35, 35A, 35B, 36	lb.	1.26	1.80
200 Fluid	lb.	3.14	4.75
ELA	lb.	.82	
FT Wax 200	lb.	.265	.42
300	lb.	.295	.45
Glycerized Liquid Lubricant, concentrated	gal.	1.25	1.63
Igepals	lb.	.2875	.74
Igepon AP-78	lb.	.44	.68
T-43	lb.	.145	.35
-51	lb.	.125	.285
-73	lb.	.285	.495
Lubrex	lb.	.27	.32
Lubri-Flo	gal.	10.00	12.05
Lustermold	lb.	.41	
L-41 Diethyl Silicone Oil	lb.	3.50	
Mold Paste	lb.	.25	
Monopole Oil	lb.	.16	
Monten Wax	lb.	.57	
Para Lube	lb.	.046	.048
Plaskon 8406, 8407	lb.	.30	.37
8416, 8417	lb.	.35	.42
8429	lb.	.40	.47
Pluronics	lb.	.335	.44
Polyglycol E series	lb.	.29	.42
RA-1, -2, -3	gal.	2.25	3.00
Rubber Glo	gal.	.94	.97
SM-33, -55, -61, -62	lb.	1.22	1.76
Soap, Hawkeye	lb.	1.35	1.45
Purity	lb.	.155	.165
Sodium stearate	lb.	.40	
Stoner's 700 series	gal.	1.20	1.25
800 series	gal.	1.26	1.70
900 series	gal.	1.55	2.55
A Series	gal.	1.80	4.50
Ucon 50-HB Series	lb.	.25	.375
Ulco	lb.	.12	.23
Vanfre	gal.	2.50	3.00

Odorants

Alamasks	lb.	.75	6.50
Coumarin	lb.	2.95	3.55
Curodex 19	lb.	4.75	5.05
188	lb.	5.75	
198	lb.	5.75	
Ethavan	lb.	6.75	7.35
Latex Perfume #7	lb.	4.00	
Neutroleum Gamma	lb.	3.60	
Rubber Perfume #10	lb.	2.60	
Vanillin, Monsanto	lb.	3.00	3.15

HOGGSON

"DUMBBELL" Test Strip Die D412(51T)

BENCH MARKER

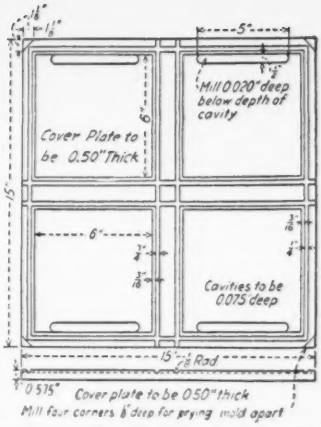
1" and 2" Centers

MALLET HANDLE DUMBBELL DIE

TOOLS, MOLDS, DIES
For Rubber Testing and Production

For making tensile test samples, we make many types of slab molds. One is detailed at the right. These are plain or chrome finished. We usually stock molds for making adhesion, abrasion, flexing, compression and rebound test samples, but supply special molds promptly. We also furnish hand-forged tensile dies for cutting regular or tear test samples.

SLAB→ MOLD D15-41


5"
Mill 0.020" deep below depth of cavity
Cover Plate to be 0.50" Thick
6"
Cavities to be 0.075 deep
15"
0.515" Cover plate to be 0.50" thick
Mill four corners ⅛" deep for prying mold apart

HOGGSON & PETTIS MFG. CO., 141S Brewery St., New Haven 7, Conn.
Pac. Coast: H. M. Royal, Inc., Los Angeles

MACHINERY & SUPPLIES FOR SALE (Continued)

COMPLETE RAW MATERIAL MIXING PLANT FOR RUBBER compounds and similar lines. Never used, in original crates 24" x 60" Farrel Rubber Mills two-roll, gear reducer and drive; conveyors, premixers, sifters, valves, crushers, scale blender, screen, dryer, dust collector, cutters. EVEREADY: BOX 638; BRIDGEPORT, CONN. EDison 4-9471—E. J. McCallum.

KUX 2½"-DIA. SINGLE-PUNCH PREFORM MACHINE. RUBBER mills from Lab. size to 84". New & used Lab. 6" x 13", 6" x 16", and 8" x 16" Mills and calenders. Baker-Perkins & Day Heavy-Duty Jack. Mixers up to 150 gals. 800-ton Hydraulic Press Multi-opening. 26" x 38" platens. 500-Ton Adamson upstroke 42" x 42" Platen. 300-ton multi-opening 40" x 40" platens. 200-ton 20" x 80" platens. 140-ton 36" x 36" platens. 150-ton 24" x 24" platens. 80-ton 18" x 18" platens. Large stock Hydr. Presses 12" x 12" to 48" x 48" platens. Hydraulic Pumps & Accumulators. Rotary Cutters. Stokes Molding Presses. Single-Punch & Rotary Preform Machines. Banbury Mixers, Crushers, Churns, Bale Cutters, Gas Boilers, etc. SEND FOR SPECIAL BULLETIN. WE BUY YOUR SURPLUS MACHINERY. STEIN EQUIPMENT CO., 107-8th Street, Brooklyn, N. Y. STerling 8-1944.

Guaranteed
NEW · USED · REBUILT MACHINERY
To Your Specification

DIVISION OF BOTWINIK BROTHERS OF MASS., INC.
SHERMAN RUBBER MACHINERY CO.

22 SHERMAN ST. • WORCESTER, MASS.

STEEL CALENDER STOCK SHELLS

ALL STEEL, ALL WELDED CONSTRUCTION, with forged steel hubs for 1¼", 1½" and 2" square bars. 4", 5", 6", 8", 10", 12", 15", 20" and 24" diameters. Any length. Also Special Trucks (Leaf Type) Racks, Tables and Jigs.

Used in manufacturing rubber and plastic products.

THE W. F. GAMMETER COMPANY
CADIZ, OHIO

HOWE MACHINERY CO., INC.
30 GREGORY AVENUE PASSAIC, N. J.
Designers and Builders of
"V" BELT MANUFACTURING EQUIPMENT
Cord Latexing, Expanding Mandrels, Automatic Cutting, Skiving, Flipping and Roll Drive Wrapping Machines.
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Acintol R	lb.	$0.065	$0.07
Adipol 2EH, 10A	lb.	.40	.435
BCA	lb.	.43	.455
ODY	lb.	.45	.485
Admex 710	lb.	.325	
711	lb.	.345	
744	lb.	.40	
Aro Lene #1980	lb.	.10	.12
Baker AA Oil	lb.	.195	.24
Crystal O Oil	lb.	.21	.255
Processed oils	lb.	.215	.235
Bardol, 639	lb.	.215	.235
B	lb.	.0625	.065
Benzoflex 2-45	lb.	.26	.29
9-88	lb.	.27	.30
Bondogen	lb.	.55	.60
BRC 20	lb.	.15	.175
22	lb.	.025	.0275
30	lb.	.0125	.021
521	lb.	.019	.02
BRH 2	lb.	.0213	.0351
BRS 700	lb.	.02	.0285
BRT 7	lb.	.03	.031
BRV	lb.	.0475	.0565
Bunarex Liquid	lb.	.0425	.0555
Resins	lb.	.065	.1225
Bunnatol G, S	lb.	.40	.505
Butac	lb.	.125	.135
Butyl stearate, comml	lb.	.255	
Binney & Smith	lb.	.23	.26
Hardesty	lb.	.23	.26
Ohio-Apex	lb.	.22	.255
Cabflex HS-10	lb.	.44	.47
G. P.	lb.	.0125	.02
R-100	lb.	.045	.0525
TT	lb.	.017	.0245
Capryl alcohol, comml	lb.	.195	.235
Binney & Smith	lb.	.18	.28
Hardesty	lb.	.18	.28
Chlorowax 40	lb.	.1625	.1825
70	lb.	.185	.245
-S	lb.	.21	.27
Circo light	gal.	.17	
Circosol-2XH	gal.	.185	
Contogums	lb.	.0875	.111
Cumar Resins	lb.	.065	.17
DBM (dibutyl-m-cresol)			
Darex	lb.	.32	.3475
DBP (dibutyl phthalate),			
comml	lb.	.30	.33
Darex	lb.	.30	.33
Eastman	lb.	.30	.33
Hatco	lb.	.30	.33
Monsanto	lb.	.30	.33
Naugatuck	lb.	.30	.33
Ohio-Apex	lb.	.30	.335
PX-104	lb.	.30	.33
Rubber Corp. of America	lb.	.30	.44
Sherwin-Williams	lb.	.30	.33
DBS (dibutylsebacate)			
comml	lb.	.66	.69
Hatco	lb.	.66	.685
Monoplex	lb.	.66	.675
Naugatuck	lb.	.665	.69
PX-404	lb.	.665	.69
DPC (dicaprylphthalate),			
comml	lb.	.295	.325
Hatco	lb.	.295	.325
Monoplex	lb.	.30	.315
DDA (didecyladipate)			
Cabflex	lb.	.425	.455
Good-rite GP-236	lb.	.40	.55
DDP (didecylphthalate)			
Cabflex	lb.	.305	.335
Good-rite GP-266	lb.	.295	.45
Hatco	lb.	.305	.435
Defoamer X-3	lb.	.355	
DIBA (diisobutyladipate)			
Cabflex	lb.	.4325	.4625
Darex	lb.	.4325	.4625
Eastman	lb.	.41	.44
Ohio-Apex	lb.	.41	.445
DIDA (diisodecyladipate)			
Monsanto	lb.	.425	.455
DIDP (diisodecylphthalate)			
Darex	lb.	.32	.35
Monsanto	lb.	.305	.335
Ohio-Apex	lb.	.295	.33
PX-120	lb.	.305	.335
Dielex B	lb.	.06	
Diethylene glycol, comml	lb.	.1525	.1825
Wyandotte	lb.	.15	.165
Dinopol IDO	lb.	.29	.325
DIOA (diisooctyladipate)			
Cabflex	lb.	.425	.455
Naugatuck	lb.	.435	.465
PX-208	lb.	.425	.455
Rubber Corp. of America	lb.	.425	.56
DIOP (diisooctylphthalate),			
comml	lb.	.305	.335
Cabflex	lb.	.305	.335
Darex	lb.	.32	.35
Eastman	lb.	.305	.335
Hatco	lb.	.305	.335
Monsanto	lb.	.305	.335
Naugatuck	lb.	.305	.335
Ohio-Apex	lb.	.285	.32
PX-108	lb.	.305	.335
Rubber Corp. of America	lb.	.305	.45
Sherwin-Williams	lb.	.32	.34
DIOS (diisooctylsebacate),			
comml	lb.	.61	.64
Rubber Corp. of America	lb.	.61	.84
DIOZ (diisooctylazelate)			
Cabflex	lb.	.48	.51
Dipolymer Oil	gal.	.33	.38
Dispersing Oil No. 10	lb.	$0.06	$0.0625
DNODP (di-n-octyl-n-decyl			
phthalate), Monsanto	lb.	.345	.375
DOA (dioctyladipate),			
comml	lb.	.425	.455
Cabflex	lb.	.425	.455
Eastman	lb.	.40	.43
Good-rite GP-233	lb.	.40	.55
Hatco	lb.	.435	.465
Monsanto	lb.	.425	.455
Naugatuck	lb.	.435	.465
PX-238	lb.	.425	.455
Rubber Corp. of America	lb.	.425	.56
DOP (dioctylphthalate),			
comml	lb.	.305	.335
Cabflex	lb.	.305	.335
Darex	lb.	.32	.35
Eastman	lb.	.305	.335
Good-rite GP-261	lb.	.285	.44
Hatco	lb.	.305	.335
Monsanto	lb.	.305	.335
Naugatuck	lb.	.305	.335
Ohio-Apex	lb.	.285	.32
Polycizer 162	lb.	.28	.435
PX-138	lb.	.305	.335
Rubber Corp. of America	lb.	.305	.45
Sherwin-Williams	lb.	.305	.335
DOS (dioctylsebacate),			
comml	lb.	.61	.64
Eastman	lb.	.61	.64
Hatco	lb.	.61	.635
Monoplex	lb.	.61	.635
Naugatuck	lb.	.615	.64
PX-438	lb.	.615	.64
Rubber Corp. of America	lb.	.61	.84
Drapex 3.2	lb.	.40	.54
Dutch Boy NL-A10 (DBP)	lb.	.30	.33
-A20 (DOP), A30 (DIOP)	lb.	.305	.335
-A54	lb.	.295	.325
-C20 (DOS)	lb.	.61	.63
-F21	lb.	.395	.425
-F31	lb.	.44	.47
-F41	lb.	.48	.51
Dutrex 6	lb.	.025	.035
Dymerex Resin	lb.	.135	.1475
Emulphor EL-719	lb.	.52	.73
Endor	lb.	.65	
Ethox	lb.	.43	.455
Ethylene glycol, comml	lb.	.135	.165
Wyandotte	lb.	.1325	.1425
Flexol 3 GH	lb.	.44	.46
3 GO	lb.	.53	.55
4 GO	lb.	.325	.355
10-A	lb.	.425	.455
426	lb.	.27	.30
810, 810X, 10-10, 10-10X	lb.	.305	.335
TOF, A-26	lb.	.435	.465
Flexricin P-4	lb.	.3475	.3625
P-6	lb.	.415	.43
P-8	lb.	.3475	.3625
PG-16	lb.	.335	.35
Fortex	lb.	.125	.145
G. B. Asphaltic Flux	gal.	.08	.14
Naphthenic Neutrals	gal.	.11	.18
Process oil, light	lb.	.025	.0325
Medium	lb.	.035	.0425
Galex W-100	lb.	.155	.18
W-100 D	lb.	.1525	.1775
Gilsowax B	lb.	.0975	.11
Harchemex	lb.	.25	.34
Harflex	lb.	1.25	1.335
40	lb.	.64	.725
50, 80, 300	lb.	.58	.665
60	lb.	.62	.705
90	lb.	.88	.965
120, 150	lb.	.305	.395
140, 160	lb.	.30	.33
180	lb.	.295	.38
220, 250	lb.	.425	.515
260	lb.	.42	.45
280	lb.	.42	.51
500	lb.	.315	.41
HB-20	lb.	.15	.17
-40	lb.	.19	.21
Heavy Resin Oil	lb.	.0225	.0375
HSC-13	lb.	.25	.32
-39	lb.	.22	.29
Hycar 1312	lb.	.60	
Indonex	gal.	.11	.19
Kapsol	lb.	.33	.355
Kenflex A, L	lb.	.26	.27
B	lb.	.23	.24
N	lb.	.18	.19
Kessoflex 103	lb.	.405	
105	lb.	.3325	
106	lb.	.38	
107	lb.	.525	
110	lb.	.24	
111	lb.	.28	
KP-23	lb.	.29	.325
-90	lb.	.40	.435
-140	lb.	.46	.485
-201	lb.	.58	.59
-220	lb.	.32	.355
-555	lb.	.565	.57
Kronisol	lb.	.33	.365
Kronitex AA, I, K-3, Mx	lb.	.325	.36
LX-685, -125, -135	lb.	.125	.135
Marvinol plasticizers	lb.	.28	.8825
Methox	lb.	.385	.41
Monoplex S-38	lb.	.215	.24
S-71	lb.	.45	.475
Morflex	lb.	.25	.65
Natac	lb	.12	.13
Neoprene Peptizer P-12	lb.	1.05	
Nevillac	lb.	.31	.85
Neville R Resins	lb.	.145	.205
Nevinol	lb.	.24	
No. 1-D heavy oil	lb.	.065	
ODA (octyldecyladipate)			
Cabflex	lb.	$0.425	$0.455
Good-rite GP-235	lb.	.40	.55
ODP (octyldecylphthalate)			
Cabflex	lb.	.305	.335
Good-rite GP-265	lb.	.29	.445
Hatco	lb.	.305	.335
Rubber Corp. of America	lb.	.305	.45
Ohopex Q-10	lb.	.295	.33
R-9	lb.	.3525	.3775
Orthonitro benzophenol,			
comml	lb.	.13	.15
Monsanto	lb.	.13	.15
Palmalene	lb.	.15	
Panaflex BX-1	lb.	.185	.225
Para Flux, regular	gal.	.10	.2125
No. 2016	gal.	.165	.24
2332	gal.	.11	
4205	lb.	.1075	.2125
Para Lube	lb.	.046	.048
Resins	lb.	.04	.045
Paradene Resins	lb.	.07	.08
Paraplex 5-B	lb.	.29	.3475
AL-111	lb.	.32	.3275
G-25	lb.	.76	.77
-40	lb.	.4825	.51
-50	lb.	.39	.4175
-53	lb.	.4325	.46
-60	lb.	.325	.35
-62	lb.	.345	.37
RG-7	lb.	.33	.335
-8	lb.	.505	.5125
-10	lb.	.52	.5275
Pepton 22	lb.	.81	.84
65	lb.	1.20	1.23
65-B	lb.	.81	.84
Philrich 5	gal.	.11	
Picco Resins	lb.	.135	.195
480 Oilproof Series	lb.	.18	.23
Aromatic Plasticizers	lb.	.05	.065
Liquid Resin D-165 (Y)	lb.	.06	.075
(Z-3)	lb.	.07	.085
(Z-6)	lb.	.08	.095
S. O. S.	gal.	.29	.34
Piccocizers	lb.	.04	.055
Piccolastic Resins	lb.	.1855	.34
Piccolyte Resins	lb.	.185	.25
Piccopale Resins	lb.	.12	.135
Piccovars	lb.	.165	.20
Piccovol	lb.	.025	.038
Pictar	gal.	.25	.30
Pigmentar	lb.	.046	.0745
Pigmentaroil	lb.	.046	.0745
Pine Tar, Sunny South	lb.	.046	.0801
Oil, Sunny South	lb.	.046	.0801
Pitch, Burgundy, Sunny			
South	lb.	.1030	.1085
Plasticizers			
42	lb.	.34	.40
B	lb.	.35	.45
DP-520	lb.	.435	.455
MP	lb.	.035	.0755
MT-511	lb.	.6925	.7425
ODX	lb.	.35	.475
SC	lb.	.40	.515
Plastoflex #3	lb.	.52	.57
#520	lb.	.36	.435
DBE	lb.	.50	.55
MGB	lb.	.29	.37
SP-2	lb.	.43	.48
VS	lb.	.3575	.3975
Plastogen	lb.	.0775	.08
Plastone	lb.	.25	.32
Polycin 470	lb.	.325	.34
Polycizers	lb.	.28	.55
162	lb.	.285	.44
Polymel C-128	lb.	.1775	.1875
D	lb.	.225	.235
D-TAC	lb.	.1975	.215
DX, C-130	lb.	.1375	.1475
PT67 Light Pine Oil	gal.	.60	
101 Pine Tar Oil	lb.	.046	.0634
Pine Tars	lb.	.046	.0634
Reogen	lb.	.1325	.135
Resin C pitch	lb.	.0225	.031
R6-3	lb.	.38	.40
Resinex 10, 25, 50, 110	lb.	.04	.045
70	lb.	.0325	.0375
85, 100	lb.	.035	.04
115	lb.	.0375	.0425
L-2, L-3, L-4, L-5	lb.	.0225	.03
Rosin Oil, Sunny South	gal.	.58	.875
RPA No. 2	lb.	.82	
3	lb.	.48	
Conc.	lb.	.85	
5	lb.	.68	
6	lb.	1.62	
RSN Flux	gal.	.10	.91
Rubber Oil B-5	lb.	.0225	.0355
Rubberol	lb.	.18	.2725
Santicizer 1-H	lb.	.50	.51
3	lb.	.46	.47
8	lb.	.43	.44
9	lb.	.39	.42
140	lb.	.325	.36
141	lb.	.34	.37
160	lb.	.25	.28
601	lb.	.325	
602	lb.	.305	
B-16	lb.	.4875	.4975
E-15	lb.	.5075	.5375
M-17	lb.	.4275	.4575
Sebacic acid, purified,			
comml	lb.	.59	.65
Binney & Smith	lb.	.64	.76
Hardesty	lb.	.64	.76
C. P.-Binney & Smith	lb.	.72	.84
Hardesty	lb.	.72	.84
Sherolatum Petrolatum	lb.	.05	.10

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FOR SALE: STEEL & STAINLESS-STEEL DOUBLE-ARM SIGMA-Blade Jacketed Mixers: 2½ to 100 gal. Marco Process, all stainless-steel consisting of: KACR Reactor, Kom-Bi-Nators, Homogenizer, Roto-Feed Mixers, Proportioners, etc. Also, Hydraulic Press, Extruders, Cutters, etc. PERRY EQUIPMENT CORP., 1424 N. 6th St., Phila. 22, Pa.

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Softener #20	gal.	$0.10 /	$0.20
Special Rubber Resin 100	lb.	.1675 /	.2175
Staflex AX	lb.	.43	
DBES	lb.	.61	.635
Syn-Tac	gal.	.33	.35
Synthol	lb.	.17	.2625
Thiokol TP-90B	lb.	.59	
-95	lb.	.65	
Tricresyl phosphate, comml.	lb.	.33	.36
Cabflex	lb.	.345	.375
Monsanto	lb.	.325	.36
Naugatuck	lb.	.33	.36
PX-917	lb.	.33	.36
Triphenyl phosphate, comml.	lb.	.39	.40
Monsanto	lb.	.39	.40
Turgum S	lb.	.1075	.1175
Tysonite	lb.	.24	.2475
United	gal.	.69	1.20
X-1 Resinous Oil	lb.	.0225	.0325

Reclaiming Oils

Acintol C, P	lb.	.02	.03
Bardol, 639	lb.	.0275	.0375
B	lb.	.0625	.065
BRH 2	lb.	.0213	.0351
BRT 3	lb.	.018	.0265
4	lb.	.025	.026
7	lb.	.03	.031
BRV	lb.	.0475	.0565
Burco-RA	lb.	.053	.0805
BWH-1	lb.	.16	.18
Dipolymer Oil	gal.	.33	.43
Dispersing Oil No. 10	lb.	.06	.0625
G. B. Oils	gal.	.10	.24
Heavy Resin Oil	lb.	.0225	.0475
LX-572	gal.	.27	.32
-759	gal.	.1375	
-777, -809, -859	gal.	.23	.33
-869	gal.	.33	.43
-871	gal.	.34	.44
No. 3186	gal.	.28	.295
Picco 6535	gal.	.25	.30
C-33	gal.	.215	.315
-42	gal.	.23	.33
D-4	gal.	.27	.37
F-5	gal.	.25	.35
Q-Oil	gal.	.286	.36
PT 67	gal.	.60	
101 Pine Tar Oil	lb.	.0427	.061
150 Pine Solvent	gal.	.44	
Reclaiming Oil #3186	gal.	.28	.385
-G	gal.	.25	.365
4039-M	gal.	.3275	.3975
-Y	gal.	.30	.37
RR-10	lb.	.37	
S. R. O.	lb.	.015	.0225
X-1 Resinous Oil	lb.	.0225	.0325

Reinforcers, Other Than Carbon Black

Angelo Shellacs	lb.	.485 /	.7325
Borden, Chem. Div.			
Arcco 978-42B	lb.	.18	.19
1073-18B	lb.	.135	.145
1294-36B	lb.	.115	.125
1301-12B	lb.	.15	.16
BRC 20	lb.	.15	.175
22	lb.	.025	.0275
30	lb.	.0125	.021
521	lb.	.019	.02
Bunarex Resins	lb.	.065	.1225
Cab-o-sil	lb.	.68	.75
Calcene NC	ton	72.50	92.50
TM	ton	75.00	95.00
Calco S. A.	lb.	.85	.88
Clays			
Aiken	ton	14.00	
Aluminum Flake	ton	22.25 /	60.00
Buca	ton	45.00	
Burgess Iceberg	ton	50.00 /	80.00
Icecap K	ton	65.00	90.00
Pigment #20	ton	35.00	60.00
#30	ton	37.00	60.00
Catalpo	ton	35.00	
Crown	ton	14.00	33.00
Dixie	ton	14.00	
Franklin	ton	13.50	35.25
L. G. B.	ton	17.00	
Paragon	ton	13.50	33.00
Pigment No. 33	ton	37.00	
Recco	ton	14.00	
Suprex	ton	14.00	33.50
Swanee	ton	12.50	
Whitetex	ton	50.00	
Windsor	ton	14.00	30.00
Witco No. 1	ton	14.00 /	30.00
No. 2	ton	13.50	30.00
Clearcarb	lb.	.1175	.1255
Cumar Resins	lb.	.065	.17
Darex Resins	lb.	.42	.49
DC Silica	lb.	1.45	1.65
Diatomaceous silica	ton	32.00 /	48.00
Good-rite Resin 50	lb.	.39	.41
K Series Polymers	lb.	.15	.37
Hi-Sil 101	lb.	.14 /	.155
233	lb.	.09	.105
X303	lb.	.40	.45
Hycar 2001	lb.	.55	
2007	lb.	.39	
Indulins	lb.	.06	.08
Kralac A-EP	lb.	.43	.54
Laminar	ton	30.00	
Magnesium carbonate, Merck	lb.	.105	.12
Marbon Resins	lb.	.39	.46
Multifex MM	ton	110.00	125.00
Super	ton	160.00	175.00
Neville Resins			
465	lb.	$0.075	$0.08
LX-509	lb.	.33	.35
Nebony	lb.	.045	.05
Paradene	lb.	.07	.08
R	lb.	.145	.205
Para Resins 2457, 2718	lb.	.04	.4575
Parapol S-Polymers	lb.	.44	
Picco Resins	lb.	.13	.225
Piccolyte Resins	lb.	.205	.275
Piccoumaron Resins	lb.	.07	.19
Piccovars	lb.	.145	.20
Pliolite NR types	lb.	.98	1.33
S-3, -6	lb.	.42	.49
-6B	lb.	.39	.46
Plio-Tuf G85C	lb.	.52	.59

CALENDAR

(Continued from page 300)

September 11-13

Division of Rubber Chemistry, ACS. Hotel Commodore, New York, N. Y.

September 12

Northern California Rubber Group.

September 18-20

National Bureau of Standards, Catholic University of America, Applied Physics Laboratory of Johns Hopkins University. Symposium—"Formation and Stabilization of Free Radicals." National Bureau of Standards, Washington, D. C.

September 23-25

American Society of Mechanical Engineers. Fall Meeting. Hotel Statler, Hartford, Conn.

September 26

Fort Wayne Rubber & Plastics Group.

October 1

The Los Angeles Rubber Group, Inc. Biltmore Hotel, Los Angeles, Calif.

October 4

New York Rubber Group. Henry Hudson Hotel, New York, N. Y.

Detroit Rubber & Plastics Group, Inc.

Financial

(*Continued from page 278*)

Wallace & Tiernan, Inc., Belleville, N. J. For 1956: net profit, $2,963,000, equal to $2.34 a share, against $2,455,208, or $1.97 a share, in 1955.

Westinghouse Air Brake Co., Wilmerding, Pa. For 1956: net income, $11,924,073, equal to $2.86 a share, against $8,382,246, or $2.02 a share, in 1955.

Three months ended March 31, 1957: net income, $3,170,224, equal to 76¢ a share, compared with $2,532,698, or 61¢ a share, in the same period last year.

Wyandotte Chemicals Corp., Wyandotte, Mich. For 1956: net earnings, $4,985,738, equal to $3.13 a common share, contrasted with $990,140, or 72¢ a share, in 1955; net sales, $79,627,750, against $63,058,975; federal income taxes, $3,850,000, against $390,000.

Purecal M	ton	$56.75 /	$71.75
SC, T	ton	110.00 /	125.00
U	ton	120.00 /	135.00
R-B-H 510	lb.	.15 /	.22
Resinex	lb.	.0225 /	.1025
Rubber Resin LM-4	lb.	.28 /	.35
Silene EF	ton	120.00 /	140.00
Silvacons	ton	55.00 /	85.00
Transphalt	lb.	.0225 /	.0525
Witcarb R	ton	105.00 /	120.00
-12	ton	45.00 /	66.00
Zeolex 23	ton	120.00 /	140.00
Zinc oxide, commercial†	lb.	.135 /	.1775

Retarders

Benzoic acid TBAO-2	lb.	.44	
E-S-E-N	lb.	.37 /	.39
Good-rite Vultrol	lb.	.62 /	.66
R-17 Resin	lb.	.1075 /	.36
Retarder ASA	lb.	.57	
J	lb.	.62	.64
PD	lb.	.37 /	.39
W	lb.	.42	
Retardex	lb.	.47	.50
Thionex	lb.	1.14	

Solvents

Bondogen	lb.	.55 /	.60
Butyrolactone	lb.	.60 /	.65
Cosol #1	gal.	.37 /	.43
#2	gal.	.42 /	.48
Dichloro Pentanes	lb.	.04 /	.07
Dipentene DD, Sunny South	gal.	.40 /	.62
Ethylene dichloride, comml.	lb.	.09 /	.122
Hi-Flash 2-50-W	gal.	.41	
Pale yellow	gal.	.39	
LX-572	gal.	.27 /	.32
-748	gal.	.16 /	.23
Methyl-2-pyrrolidone	lb.	.75 /	.80
Neville Nos. 100, 104	gal.	.52 /	.60
106	gal.	.38 /	.46
Nevsolv H, 200	gal.	.19 /	.29
HF, T, 30	gal.	.24 /	.34
Penetrell	gal.	.40 /	.62
Picco Hi-Solv Solvents	gal.	.16 /	.48
Pine Oil DD, Sunny South.	lb.	.1225 /	.1425
PT 150 Pine Solvent	gal.	.44	
Skellysolve-B	gal.	.17	
-H	gal.	.148	
-R, -V	gal.	.139	
-C	gal.	.162	
Stauffer Carbon Disulfide	lb.	.0525 /	.085
Tetrachloride	lb.	.0825 /	.475

Tackifiers

Acintol R	lb.	.065 /	.07
Bardol, 639	lb.	.0275 /	.0375
Borden, Arcco			
A25, A26, 716-30	lb.	.18 /	.19
555-40R	lb.	.185 /	.205
620-32B	lb.	.20 /	.21
716-35	lb.	.17 /	.18
1041-21	lb.	.165 /	.175
BRH 2	lb.	.0213 /	.0351
Bunarex Resins	lb.	.065 /	.1225
Chlorowax 70	lb.	.18 /	.24
Contogums	lb.	.0875 /	.11
Cumar Resins	lb.	.065 /	.17
Galex W-100	lb.	.155 /	.17
W-100D	lb.	.1525 /	.1625
Indopol H-35	gal.	.65 /	.81
H-50	gal.	.70 /	.86
-100	gal.	.85 /	1.05
-300	gal.	1.00 /	1.21
L-10	gal.	.40 /	.56
-50	gal.	.45 /	.61
-100	gal.	.55 /	.71
Kenflex resins	lb.	.18 /	.27
Koresin	lb.	.90 /	1.10
Natac	lb.	.12 /	.13
Nevindene	lb.	.15 /	.18
Picco Resins	lb.	.13 /	.185
Piccolastic Resins	lb.	.1855 /	.34
Piccolyte Resins	lb.	.185 /	.25
Piccopale Resins	lb.	.089 /	.13
Piccoumaron Resins	lb.	.07 /	.185
R-B-H 510	lb.	.15 /	.22
Roelflex 1118A	lb.	.39	
Synthetic 100	lb.	.41	
Synthol	lb.	.17 /	.2625
United	gal.	.69	1.20

Vulcanizing Agents

Dibenzo G-M-F	lb.	2.60	
G-M-F #113, #117	lb.	.90	
HMDA-Carbamate	lb.	4.50	4.90
Ko-Blend I, S	lb.	.39	
Litharge (*See Accelerator-Activators, Inorganic*)			
Magnesium oxide	lb.	.2525	.38
Merck, Light Calcined	lb.	.2525 /	.26
Extra Light Calcined	lb.	.2925 /	.30
Red Lead (*See Accelerator-Activators, Inorganic*)			
Sulfasan R	lb.	1.50	
Sulfur flour, comml.	100 lbs.	2.55 /	3.30
Aero	100 lbs.	2.40 /	7.75
Crystex	lb.	.195	.23
Insoluble 60	lb.	.15	.155
Rubbermakers	100 lbs.	2.65 /	4.55
Stauffer	lb.	.0265	.054
Telloy	lb.	2.50	
VA-7	lb.	.50	.60
Vandex	lb.	15.50	
Vultac No. 2	lb.	.47 /	.755
3	lb.	.51 /	.795
White lead silicate (*See Accelerator-Activators, Inorganic*)			

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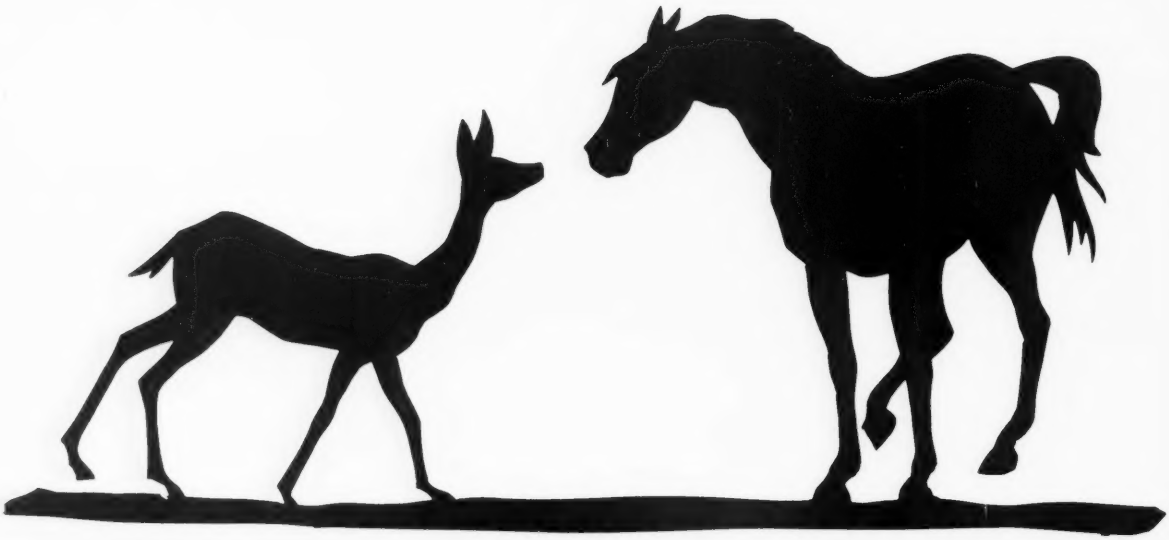

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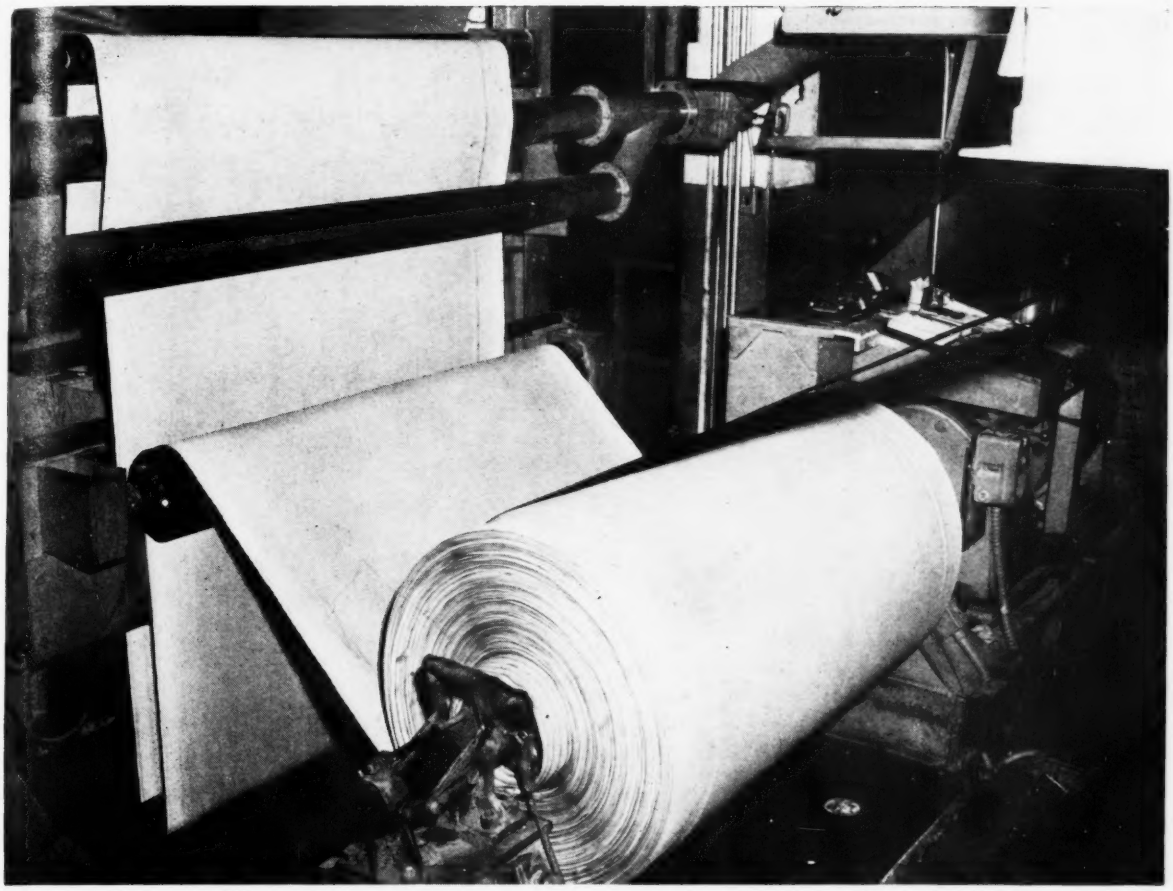

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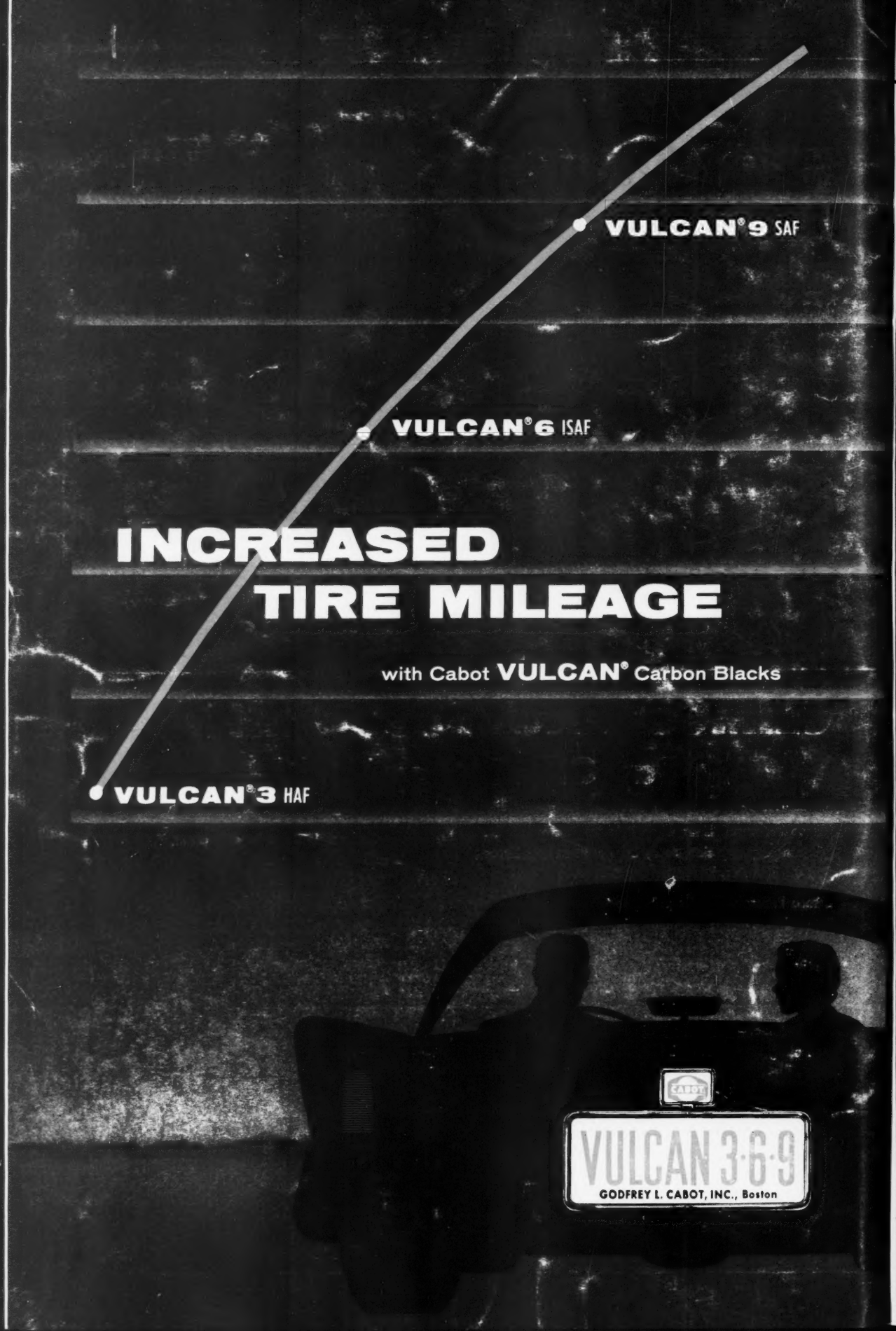
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